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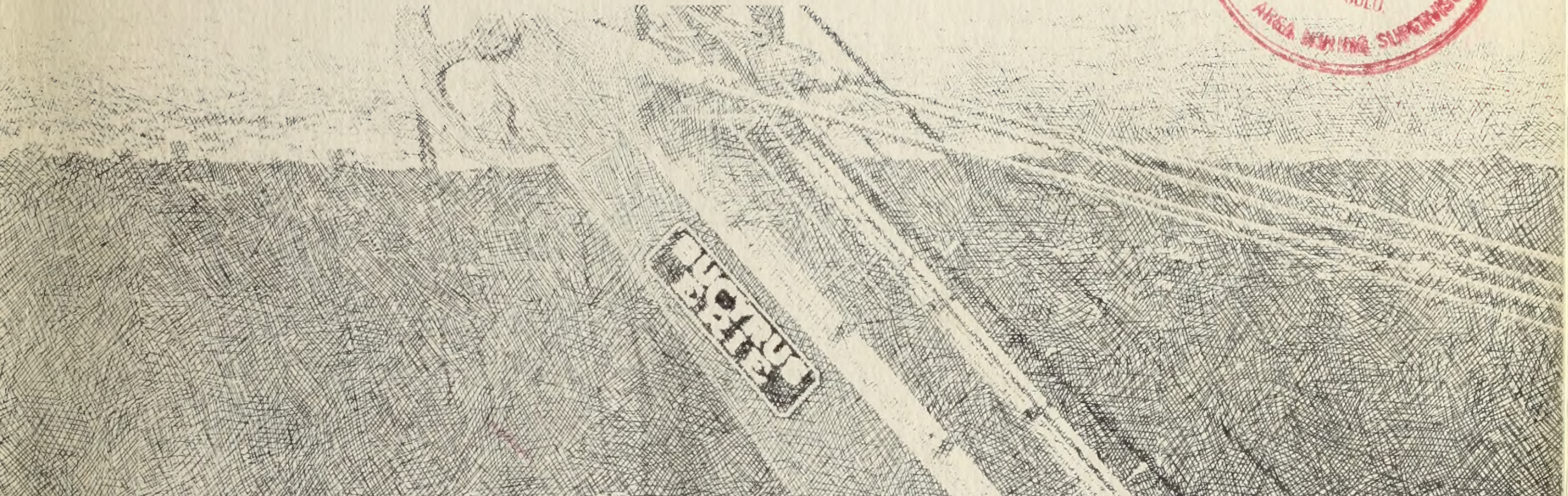

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PREPARED BY

VTN COLORADO, INC.
6875 EAST EVANS AVENUE
DENVER, COLORADO 80222

JUNE, 1974

vtn colorado

ENGINEERS ARCHITECTS PLANNERS 6875 EAST EVANS AVE. DENVER, COLORADO 80222 (303) 759-4271

July 15, 1974

Mr. Charles W. Margolf
Director of Western Operations
W.R. Grace & Co.
1860 Lincoln Street
Lincoln Tower Building
Suite 150 M
Denver, Colorado 80205

Dear Mr. Margolf:

VTN is pleased to submit to you the Draft Environmental Statement for the proposed Colowyo Mine, a project of the Colowyo Coal Company which is a division of W.R. Grace & Co. This Report is prepared in accordance with the requirements established by the United States Geological Survey (USGS) in accordance with their procedures for the preparation of Environmental Impact Statement.

VTN has examined virtually the entire range of environmental problems facing construction, operation, and maintenance of the proposed Colowyo Mine. Ways in which adverse impacts can be mitigated or avoided have been emphasized. Special consideration has been given to the amplification of the Project Description and Alternatives to the proposed action. Included also is a synopsis of the Draft Environmental Impact Statement with a USGS Environmental Matrix which is designed to highlight the impacts and their mitigative measures.

We are appreciative of the total cooperation and extensive review and comments from the various personnel of W.R. Grace & Co. and Gates Engineering. We would also like to thank the United States Geological Survey and the Bureau of Land Management for their helpful review and comments relative to the contents of this report.

We appreciate the opportunity to perform the draft environmental impact statement for this proposed project. Please feel free to contact us at any time should you have any questions concern-

ing this report or if we can be of further assistance to W.R. Grace & Co.

Very truly yours,

Douglas M. Ross, P.E.
Douglas M. Ross
Project Manager and
Director of
Environmental Sciences
Rocky Mountain Province

Mary C. Battershill
Mary C. Battershill
Project Coordinator and
Department Chief of Socioeconomics

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INTRODUCTION

I. INTRODUCTION

A. JURISDICTION

The following Draft Environmental Impact Statement is prepared as an information document for the United States Geological Survey, delineating and objectively evaluating from an environmental viewpoint the proposed coal mine on Taylor Creek near Axial, Colorado, hereinafter referred to as the "Colowyo Mine." This report is written in accordance with the Revised National Environmental Policy Act (NEPA) of 1973 and follows the suggested outline of NEPA and The United States Geological Survey "Procedure for Evaluating Environmental Impact," Geological Survey Circular #645.

B. AUTHORIZATION

VTN submitted a proposal to W. R. Grace & Co. on April 16, 1974. VTN has performed this study based upon the scope of work set forth in that proposal after receiving authorization to proceed from Mr. Charles W. Margolf, Director of Western Operations, W. R. Grace & Co., on behalf of the Colowyo Coal Company.

VTN has worked closely with the various city, county, and Federal agencies having jurisdiction over the proposed mine site. In particular, the Williams Fork planning study prepared by the Craig District Bureau of Land Management was used extensively to coordinate both the activities and mitigative suggestions proposed in that study with the environmental impact planning processes outlined in this report.

C. BACKGROUND

The project site has had a previous history of underground mining operations. In 1914, a coal mine was opened on the property by the Collum Coal Company. In 1945, this mine was purchased by the Colowyo Coal Company. The "Collum" Mine was renamed the "Red Wing" Mine and operated as a small producer until 1974 when a Federal mine inspector closed the Red Wing Mine due to the presence of carbon monoxide in the shafts.

There was a second mine in the same area known as the "Streeter" Mine which was owned and operated by the Streeter Coal Company and was also an underground coal mine. The Streeter Mine operated until 1951 when the workshop collapsed. In 1952, fire

was discovered in a coal seam in the closed Streeter Mine. This fire is still burning and is believed to have resulted from spontaneous combustion. It is also believed that the fire from the Streeter Mine caused the presence of carbon monoxide in the Red Wing Mine. The Red Wing Mine, pursuant to order of the Federal mine inspector, has been closed and all portals sealed.

The location of the closed Red Wing Mine is shown on Figure 7, and is located at the eastern edge of the Colowyo Mine property. The proposed strip mining activities will not occur on the closed Red Wing Mine site, but will, in later years, occur to the south of the old mine in the area delineated as Region 7 on Figure 7.

D. PERMITS

Table 1 gives the various permits necessary for the development of the Colowyo Mine.

E. ACKNOWLEDGEMENTS

The comprehensive nature of this study has required contact and coordination with a great number of people and with a wide variety of organizations. It is not feasible for the consultants to acknowledge all of the assistance and inputs that have assisted in the preparation of this report. Credit is due to the support and contributions of the following ogranizations and individuals: Bureau of Land Management in Craig, Colorado; United States Geological Survey; Planning agencies in the cities of Craig and Meeker; Dale Egner, Consulting Geologist with FUGRO, Inc. and Dr. D.A. Breternitz, Director of the Mesa Verde Archaeological Research Center.

The following VTN personnel were instrumental in the preparation of this report: Dr. Paul J. Epley, Ph.D., Ecologist; Douglas M. Ross, Director of Environmental Sciences Division and Project Manager for this report; Mary C. Battershill, Social Psychologist and Project Coordinator; and Hugh Bollinger, Ph.D, Botanist.

TABLE 1

PERMIT INFORMATION TABLE
COLOWYO COAL MINE

Description	Granting Authority	Reference	Method of Application	How Approved	Required Filing Date	Approval Date	Description
1. Intent to Mine Mine License	Chief Coal Mine Inspector, State of Colorado.	Coal Mining Laws, State of Colorado	Letter of Application	Issuance of License	Prior to Mine Opening		License issued upon payment of fee. Fee varies depending on size of the mine paid on a yearly basis. 0.7 cents per ton payment for inspection fee.
2. Approval of Mining Plans	District Mining Supervisor, Mining Branch, Conservation Division, U.S.G.S.	Operating Regulations to Govern Coal Mining Method and the Safety and Welfare of Miners on Leased Lands on the Public Domain Sec. 22	Complete Mining Plans and Letter	Not Specific	Prior to Opening		Any modifications of original plans must also be approved by District Mining Supervisor.
3. Mine ID Number	U.S. Bureau of Mines, District or Subdistrict Office	Federal Register, Section 75.1721	Letter of Information	Letter	Prior to Opening		ID Number assigned after mine notification given.
4. Plans and Information	U.S. Bureau of Mines or Subdistrict Office	Federal Register, Section 75.1721	Letter and Plans	Approval Letter	Prior to Opening or Start of Work		11 specific items required to be submitted. No work permitted until the plans are approved. Forms obtained from Bureau of Mines.
5. Minimum Roof Control Plans	U.S. Bureau of Mines	Federal Register, Section 75.1721	Form 6-1496	Permit			Part of plans required for line No. 4. Review every six months.
6. Electrical Face Equipment List	U.S. Bureau of Mines	Federal Register, Section 75.503.1	Form 6-1496	Letter	After Production		List all electrical equipment being used, being repaired or stored.
7. Active Mine Workings	U.S. Bureau of Mines, District or Subdistrict Office	PL 91-173, Section 202(a)	Form 6-1497	Permit			To be submitted annually.
8. Mine Maps	District Mining Supervisor, Mining Branch, etc.	Operating Regulations, Section 28(F)	Letter and Map	No approval required	Annually		To be submitted annually. May be required semi-annually if requested by District Mining Supervisor.
9. Mine Maps	State Coal Mine Inspector	Coal Mining Laws, State of Colorado, Article 7	Map	No approval required			Must be extended by licensed engineer or surveyor every six months. Copy sent to Chief Coal Mine Inspector.
10. Yearly Report and Monthly Reports	State Coal Mine Inspector	Coal Mining Laws, State of Colorado, Article 92-10-32, 92-10-33	Forms Supplied by State Mine Inspectors Off.	No Approval Required	15th of each month and 31st of January		Monthly reports by 15th of month covering preceding month. Yearly report by 31st of January covering preceding year.
11. Production Report	District Mining Supervisor	Operating Regulations, Section 9(A)	Approved Reporting Form		30 days after the completion of a quarter		On lease anniversary a yearly report shall also be submitted. Reported on mines run basis.

Description	Granting Authority	Reference	Method of Application	How Approved	Required Filing Date	Approval Date	Description
12. Annual Audit	District Mining Supervisor	Operating Regulations, Section 9(b)	Financial Statement	Yearly Report	30 days after completion of lease year		An accountant audit. Eligibility of accountant approved by Secretary of Interior.
13. Noise Level Test	U.S. Bureau of Mines	Federal Register, Section 70.500 to 70.510	Coal Mine Noise Data Report Form	Acceptance of Notice of Violation	When in Production		Sent to U.S. Bureau of Mines but certified also to Department of Health, Education and Welfare.
14. Respirable Dust Samples Underground	U.S. Bureau of Mines	Federal Register, Section 70.201-279, Section 71.100-113	Sample and Manufacturing Data Card	Report	When in Production		Applies to both surface and underground workers.
15. Conditions (Dust Control) in Active Workings	U.S. Bureau of Mines	Federal Register, Section 70.272	Form 6-1497	No Approval	June 30 Annually		
16. Availability of Mine Maps	U.S. Bureau of Mines	Federal Register, Section 75-1203	Upon request letter and map		When Requested		Inspection by Bureau of Mines. Upon request copy to Secretary of Interior and Secretary of HUD.
17. Air Pollution Emissions Survey	Protection Agency Air Act	PL-91-604, Section 114	Report on form		When in Operation		
18. Fatalities, serious injuries, etc.	State Coal Mine Inspector, District Supervisor, USGS, District Manager, USBM						All agencies must be notified. Investigation required before work can be resumed. County Coroner must also be notified.
19. Sewerage Effluent	U.S. Corps of Engineers	Refuse Act of 1899 and related laws	Forms 4345 and 4345.1 Corps of Engineers	Permit			Applies unless sewage system is in a municipal or other public sewage treatment system.
20. Disposal of Mine Refuse	U.S. Corps of Engineers	Refuse Act of 1899 and related laws	Forms 4345 and 4345.1 Corps of Engineers	Permit			

SYNOPSIS

11. SYNOPSIS

A. SUMMARY OF THE PROPOSED COLOWYO MINING PROJECT

The Colowyo Coal Company, which is a division of W.R. Grace & Co, plans to surface mine it's recoverable coal reserve at their property located south of Axial, Colorado. The objective of the Colowyo Coal Company is to supply high quality, low sulfur sub-bituminous "A" coal to meet the energy needs of the nation. The Colowyo Coal Company plans to mine a total of 35,572,700 tons of coal during its operation, to a depth of 140 feet by removing 180,746,100 cubic yards of overburden.

The Colowyo Coal Company plans to begin production in the third quarter of 1975 at an annual rate of 600,000 tons per year. Production will be raised each year until 1979 when maximum production of 3,000,000 tons per year is achieved.

The reserves will be mined by the area strip method using two draglines, a 24 ton dragline and a 40 ton dragline, which have a combined stripping capacity of approximately 15 million cubic yards per year.

Land reclamation and revegetation will commence immediately with the start of the proposed project. The revegetation plan will comply with the Colorado Open Mining Land Reclamation Act. Details of the Mining Plan are given in Section 111.

B. SUMMARY OF EXISTING ENVIRONMENT

The landscape surrounding the proposed Colowyo Project is composed of a mosaic of characteristics. This Environmental Impact Statement covers all of these facets.

Hydrological Environment:

The Colowyo Mine properties are bisected by two distinct ephemeral stream systems. These are the Street Creek which drains west into the perennial Good Springs Creek and Taylor Creek which flows northerly into Wilson Creek which is also perennial. There are alluvial aquifers associated with these waters but they do not constitute a major source of water reserve.

Biological Environment:

The land surrounding the proposed mine is characterized by sagebrush steppe, brush communities and pinyon-juniper woodland. These are extensive vegetation types for that region, climate and topography of the western Rocky Mountains. Wildlife, especially

deer and elk are common in the area. Rare and endangered species are not known to exist anywhere on the property.

Geological Environment:

The physical environment of the Colowyo Mine and vicinity is straightforward and relatively uncomplicated. Topography and geologic structure reflext the gentle warping of the region associated with the axial basin uplift and subsequent incision by drainage channels. The rock units underlying and outcropping on the site follow a normal succession, are relatively flat-lying, and exhibit only minor flexures which deviate from the regional trend. Soil ranges in depth from 20-40 inches and portions contain on the order of 5 percent organic matter. Ground water primarily located in the alluvial material of the valleys with minimal amounts perched in strata which outcrop on the mesa edges. Seismically, the site and adjacent areas appear to have been an area of low seismicity in the past.

Sociological Environment:

The socioeconomic environment for the Colowyo Mine encompasses the social organization of the communities and region affected by industrial and population growth. These are the communities of Craig (Moffat County) and Meeker (Rio Blanco County). The social organization of the area includes a description of the population and employment patterns, the economic base, community and social services as well as land use and ownership patterns. Recent developments in planning and land use, in building and development and in mining development will provide a forecast of background changes which will occur during the project. Mining development will necessitate a number of changes in affected cities and towns and will require expansion of various community facilities in order to supply projected growth. Socioecomics is a complex issue; a clearer indication of the current environment within the study area and the impacts associated with Mining Development are included in the appropriate sections of this report.

C. SUMMARY OF IMPACTS

Impacts resulting from the proposed Colowyo Mine Plan are discussed in detail in Section V. The following Matrix is a summary of the impacts and their magnitude, and is designed using the U.S. Geological Survey Circular 645, "A Procedure for Evaluating Environmental Impact".

The vertical axis of the matrix defines the mining activities which may cause environmental impact. The horizontal axis defines those elements of the environment which will be impacted. The impacts are evaluated in order of their magnitude, in the

upper left hand corner of the box created by the intersection of the two axis, on a scale of one to ten, ten representing the greatest impact, one representing little or no impact. The + designates that the impact is beneficial, the "P" designates that the impact is problematic (or that there is not enough information to adequately assess the impact). The number that appears in the lower right hand corner of the box ranks the importance of the impact; again, ten representing the greatest importance, one representing the least importance. The assignment of numerical weights is somewhat subjective, and in this respect debatable, however, the evaluations in the matrix are based on data recorded in this report and on other factual data available; the evaluations are assessed as objectively as humanly possible.

The degree of importance (signified by the number in the lower right hand corner of the box created by the axis of the two planes of evaluation) in this matrix is based upon whether or not the impact is mitigatable. Therefore, significance can be easily seen by the higher ranking, or higher numbers. These higher rankings should be taken seriously, since they are most often those which are unavoidable adverse impacts. For example, fugitive dusts resulting from removal of overburden in an uncontrolled situation, is ranked at 8. However, as evidenced by the degree of importance, or mitigation of the impact, the dusts can be partially mitigated by controlled methods (such as watering) and can lessen the significance of the impact to average the impact to around 4.

There are problems associated with numerical rankings as those proposed in this matrix. The degree of impact and the significance of the impact cannot always be measured. For instance, the impact of the development on intangible factors such as aesthetics and quality of life cannot easily be evaluated since the degree of impact and importance lies with individual preference. These are termed problematic since there is no objective method of evaluation.

In summary, the impacts resulting from the proposed Colowyo Mine are mainly those resulting from unavoidable causes; for instance, alteration of land form, use of non renewable energy sources, increased population and its resultant impacts, alteration of migration patterns due to the presence of a mine and inhabitance, elimination for a short-term of vegetation, fugitive dusts, and the removal of coal.

However, the beneficial impact should be also stressed; that is, the supply of a high BTU, low sulfur coal, which is in demand by utility companies in the United States.

IMPACTS EXISTING ENVIRONMENT	BUILDINGS & FACILITIES	REMOVAL OF OVERBURDEN	COAL EXTRACTION	ACCESS CORRIDORS	BLASTING & DRILLING	STOCKPILING SPOILS & TOPSOIL	CULVERT ON TAYLOR CREEK	TRUCK TRANSPORT	EQUIPMENT EMISSIONS	COAL PROCESSING	SURFACE WATER RUNOFF	GROUNDWATER SUMPING	WASTEWATER DISPOSAL	SOLID WASTE DISPOSAL	NOISE AND VIBRATION	EMPLACEMENT OF TAILINGS, SPOIL OVERBURDEN	CONTOUR GRADING	REVEGETATION	SCHOOLS	HOUSING UTILITIES	COMMERCIAL AND COMMUNITY FACILITIES	EMPLOYMENT INCOME	FENCING
LANDFORM	2/0	9/0	9/0	2/0	—	7/0	—	—	—	—	—	2/0	—	4/5	—	+7/7	+6/5	—	—	—	—	—	—
SOILS	1/0	10/5	5/5	7/5	—	4/0	—	—	—	2/0	4/0	2/0	—	3/4	—	+5/5	2/5	+8/5	—	—	—	—	—
GEOLOGY	—	6/0	6/0	—	5/0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AVAILABILITY OF MINERAL RESOURCES	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
EROSION	7/5	5/7	—	7/5	1/0	8/7	5/5	—	—	—	8/7	2/1	3/5	1/0	—	6/7	+8/7	—	—	—	—	—	—
DEPOSITION	4/4	4/6	4/6	6/4	—	8/7	2/0	—	—	2/0	8/5	5/5	8/7	2/3	—	8/7	+9/7	—	—	—	—	—	—
SUBSIDENCE	1/0	—	8/9	—	3/0	3/0	—	—	—	—	—	—	—	3/1	—	2/0	—	—	—	—	—	—	—
GROUNDWATER	—	7/10	7/10	—	3/0	—	2/0	—	—	—	3/3	1/0	4/0	5/5	—	—	—	+2/0	—	—	—	—	—
SURFACE WATER	3/5	5/6	5/6	4/5	—	3/6	6/5	—	—	3/4	6/5	4/2	6/4	4/2	—	+3/6	+3/0	+4/0	—	—	—	—	—
WATER QUALITY	2/1	4/3	4/3	1/0	2/0	6/5	—	—	—	2/4	P	2/2	5/7	3/5	—	P	—	—	—	—	—	—	—
DRAINAGE PATTERNS	1/0	8/5	8/5	2/3	—	7/5	1/0	—	—	—	5/6	—	—	4/5	—	+5/5	+5/5	—	—	—	—	—	—
MICRO-CLIMATE	2/1	7/10	—	5/5	—	2/3	—	—	8/1	—	5/10	—	—	—	4/10	—	2/2	—	—	—	—	—	—
FUGITIVE DUSTS	—	10/5	7/4	6/3	8/6	10/5	—	—	7/3	—	—	—	—	—	—	—	8/3	—	—	—	—	—	—
CASES & PARTICS.	—	8/6	5/3	—	—	8/6	—	—	8/6	8/2	—	—	—	—	—	—	—	—	—	3/2	*3/2	—	—
VEGETATIVE COMMUNITIES	6/0	10/0	—	5/0	4/3	5/0	—	—	—	—	8/10	5/10	7/10	4/10	—	—	—	—	—	—	—	—	—
WILDLIFE HABITAT	5/6	10/1	—	9/1	10/1	5/2	2/8	—	—	—	—	—	—	—	—	+10/0	+10/0	+10/0	—	—	—	—	5/2
RARE & ENDANGERED SPECIES	—	P	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MIGRATION PATTERNS	5/5	10/1	—	10/4	10/1	5/3	—	—	—	—	4/10	—	—	—	8/10	—	+10/0	—	—	—	—	—	8/2
OPEN SPACE	8/3	10/1	—	5/1	—	5/1	—	—	—	7/1	—	3/5	5/0	5/0	—	+6/0	+6/0	+10/0	—	—	—	—	—
AGRICULTURE & GRAZING	5/0	10/0	10/0	5/0	5/0	—	—	—	—	—	—	—	—	—	—	—	—	+10/0	—	—	—	—	5/5
RESIDENTIAL/INDUST./COMMER.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+10/P	+10/P	+10/P	—
RECREATIONAL AREAS	—	3/0	3/0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+5/0	—	—	—	—	—
TRANSPORTATION NETWORKS	—	—	—	6/3	—	—	—	8/2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AESTHETICS	3/0	4/0	4/0	6/4	6/0	4/0	1/0	1/0	—	—	—	4/0	4/0	4/0	—	+10/0	+10/0	+10/0	—	—	—	—	4/0
ARCHAEOLOGIC, PALEONTOLOGICAL	P	P	P	P	P	P	—	—	—	—	—	—	P	P	—	—	P	P	—	—	—	—	P
& HISTORIC SITES	P	P	P	P	P	P	—	—	—	—	—	—	P	P	—	—	P	P	—	—	—	—	P
POPULATION	—	—	—	—	—	—	—	—	6/3	—	—	—	—	—	2/0	—	—	—	—	10/5	10/5	+10/5	—
HEALTH & SAFETY	5/5	—	5/5	—	5/5	—	—	—	—	5/5	—	—	—	—	—	—	—	—	—	—	—	—	—
TAX REVENUES & LAND VALUES	+5/0	—	+10/0	—	—	—	—	—	—	—	—	—	—	—	—	+10/0	—	—	—	—	—	+10/0	—

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LEGEND

A/B=T WHERE A = UNCONTROLLED IMPACT INTENSITY
B = MITIGATION BY CONTROL METHODS
T = AVERAGE SIGNIFICANCE OF THE IMPACT

P: PROBLEMATIC
*: INDIRECT SOURCES
+: BENEFICIAL IMPACT

ENVIRONMENTAL MATRIX

DESCRIPTION OF THE PROPOSED PROJECT

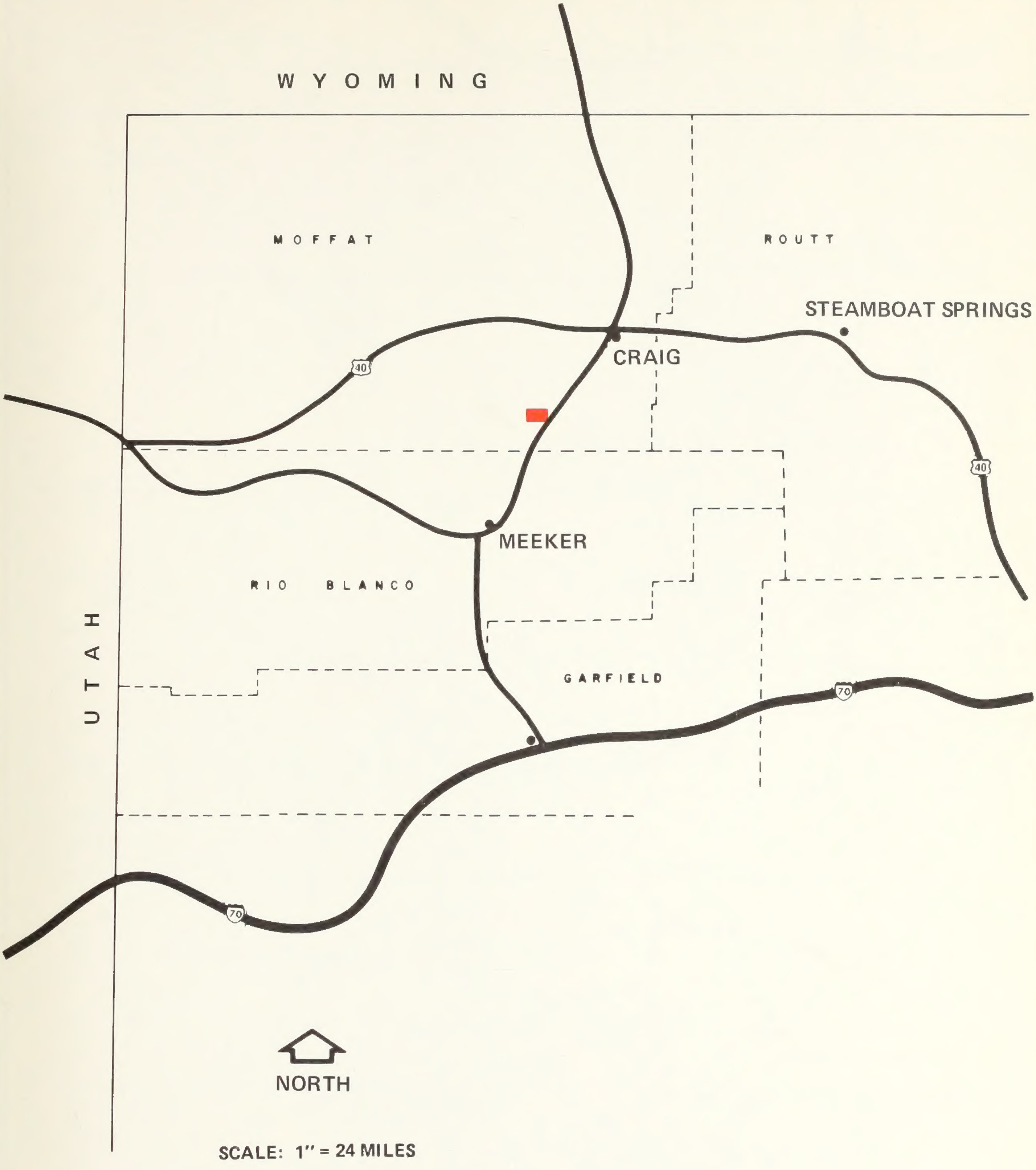
III. DESCRIPTION OF THE PROPOSED PROJECT

A. LOCATION

The proposed mining operation of Colowyo Coal Company, a division of W. R. Grace & Co., herein called the Colowyo Mine, is located in the Danforth Hills Coal Fields, Moffat County, Colorado, on the edge of the Axial Basin as shown in Figure 1. The mine area is approximately 25 miles southwest of Craig, Colorado, and one mile southwest of the small town of Axial (see Figure 2). According to Federal Coal Lease Denver 034365, the W. R. Grace & Co. is entitled to mine coal in three quarters of Section 2, all of Sections 3 and 4, one half of Section 9, one half of Section 10 in Township 3N, Range 93W and one fourth of Section 34, Township 4N, Range 93W. Legislative action now pending (see Mining Leases) could extend the permissible mining areas in Sections 5, 8, 9, and 10. The presently approved sections contain 2,565 acres, of which approximately 1,830 acres (71.3 percent) are considered surface mineable. Of the remaining 735 acres, 100 acres are planned for utilization as haul and access roads, highway and coal transport right-of-ways, topsoil and overburden storage, and field offices and machine shops. The remaining 635 acres, approximately 25 percent of the total acreage, will remain as open space.

B. OBJECTIVES

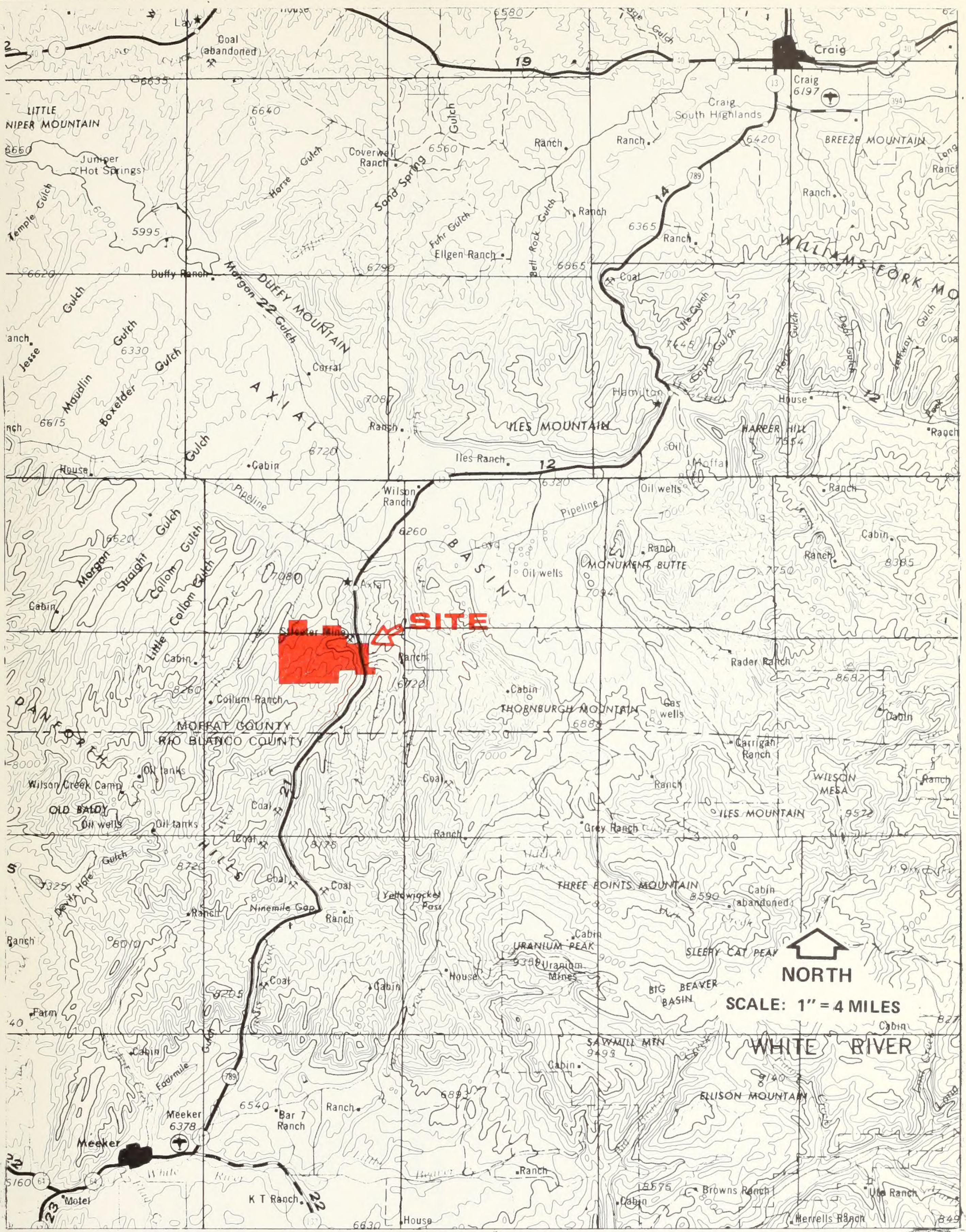
The objectives of the proposed Colowyo Mine are to provide high grade, low sulfur sub-bituminous "A" coal to meet the energy needs of various regions of the nation while at the same time meeting the high standards set up by the Clean Air Act of 1969. To meet these objectives, the W. R. Grace & Co. has devised a Mining plan that is both economically feasible and environmentally sound for their properties in northwestern Colorado. Table 2 summarizes the quality of Colowyo coal as it exists in six principal seams relative to ash, sulfur and BTU (British Thermal Unit) content. Table 3 represents the relationship of the coal quality of the Colowyo Mine as compared to the utility industries standard of high quality coal. Analysis of this data indicates that the compustion of the coal would produce less than one half of the 1.2 pounds of sulfur dioxide per million BTU specified by the Clean Air Act.



LOCATION MAP OF PROJECT AREA

Source: Colorado State Dept. of Highways, 1974

FIGURE 1



LOCATION OF COLOWYO MINE SITE

SOURCE: COLORADO STATE DEPT. OF HIGHWAYS

FIGURE 2

TABLE 2

RANGES OF ASH, SULFUR AND BTU DETERMINATIONS FROM CORE SAMPLES (AS-RECEIVED BASIS)
REDWING MINE
COLOWYO COAL COMPANY

	Thickness (Feet)		Ash (Percent)			Sulfur (Percent)			Btu			Cores
Seam	Minimum	Maximum	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average	Analyzed
X	10.0	14.0	3.71	24.36	7.97	0.14	0.59	0.26	7,943	10,749	10,114	17
D	6.1	9.9	4.82	8.58	6.85	0.32	0.55	0.41	10,270	11,146	10,575	6
G	11.9	21.5	3.51	6.15	4.61	0.21	0.46	0.34	10,889	11,557	11,278	4
H	16.0	22.0	3.71	8.70	6.05	0.29	0.55	0.44	10,896	11,685	11,138	5
I	16.9	23.0	4.76	7.99	6.16	0.45	0.55	0.48	11,023	11,303	11,185	3
J	12.0	15.0	4.16	11.05	8.84	0.52	0.56	0.54	10,136	12,287	11,007	2

Source: Colowyo Mining Company, 1974

TABLE 3

RELATIONSHIP OF COLOWYO COAL QUALITY TO UTILITY INDUSTRY STANDARDS FOR COAL QUALITY

Industry Rate	Heat Content BTU's Per Pound	Sulfur Content Percent	Ash Content Percent	Moisture Content Percent
Considered High Quality by Steam Coal Industry	12,000 BTU's or more	0.7 or less	8.0 or less	10.0 or less
Colowyo Coal				
Strip Coal	10,500	0.3	8.0	15.0
Average of all Seams	12,248	0.3	3.0	15.0

C. MINING LEASES

The coal is controlled by Federal Coal Lease Denver 034365. This is a "modified" lease which allows increases in mine acreage up to 2,560 acres. In 1945 the properties comprised 310 acres. Since that time the predecessor in title of W. R. Grace & Co. applied for four lease modifications which were processed and approved, increasing the mineable acreage to 3,724.73 acres. However, under the conditions of the federal coal lease statutes, (30 U.S.C. Section 203) the lease acreage must be reduced. Colowyo Coal Company is presently undertaking measures to comply with this statute. Boundaries of the existing leases and the proposed leases are shown on Figure 3.

D. MINING OPERATIONS

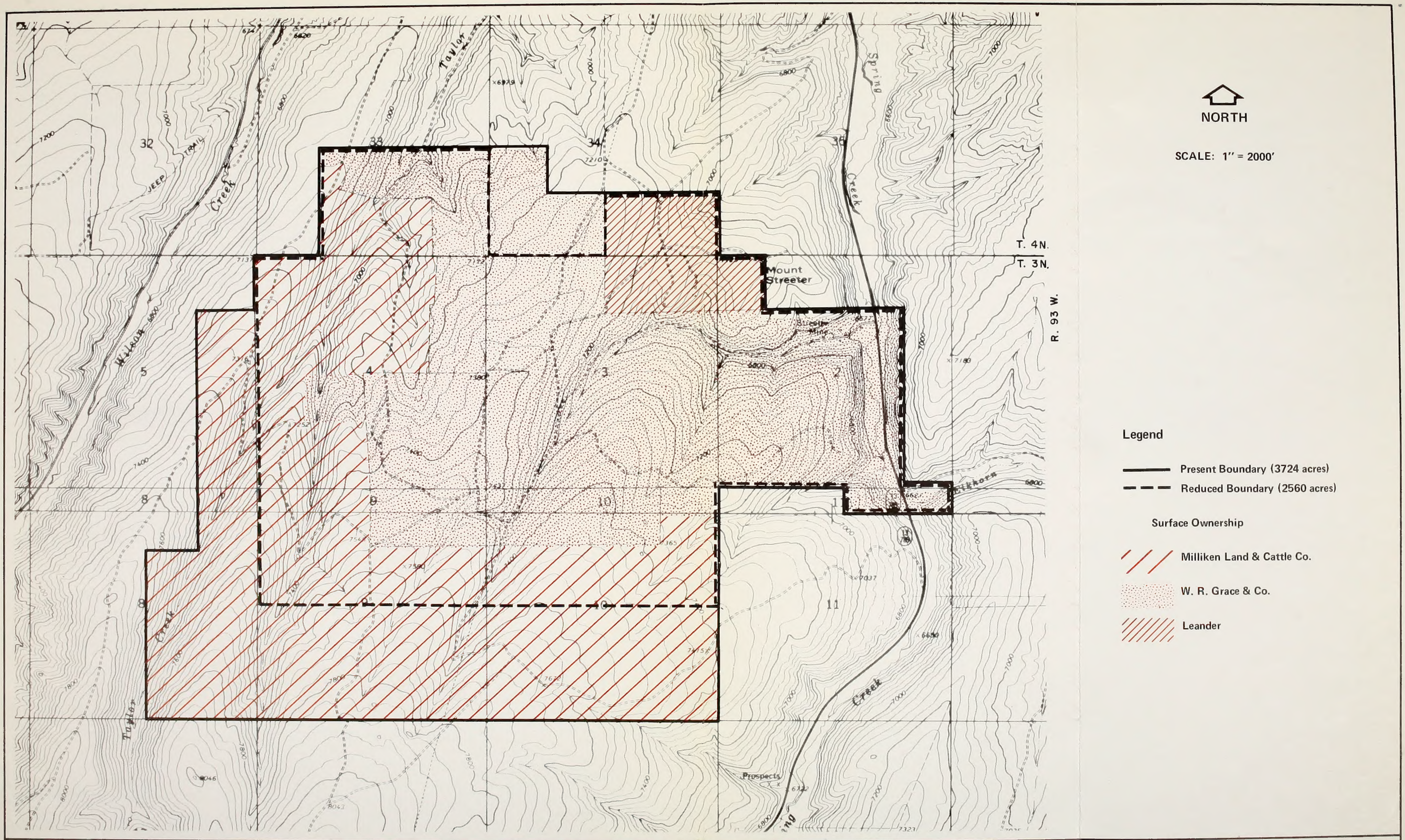
1. ACCESS

The Colowyo Mine property is reached by traveling southwest on Colorado State Highway 13 from Craig. Numerous unimproved dirt roads dissect the property and adjoining lands. Initial mining plans (see Section 2c) require that an all-weather paved road, approximately 40 feet wide, be constructed up Taylor Creek in Sections 22 and 27, Township 3N, Range 93W. Within the actual mining area, various haulage and access roads will be needed to facilitate the extraction of the coal. This is expected to be a very limited road network with the maximum distance of coal haulage on the property to be less than three miles. All roads will be constructed above any potential flash flood levels.

2. TECHNIQUES AND EQUIPMENT

Mining coal by the area strip method is planned for the Colowyo Mine. Essentially, this method consists of a series of earth moving operations as shown on Figure 4. First the topsoil is removed by surface scrapers and bulldozers and deposited in holding areas. Secondly, the overburden is removed, after blasting, by a dragline to the top of the coal seam to be initially mined. Initial plans call for the use of a dragline with a 28 yard capacity. Depending upon delivery time tables, a second dragline with a 40 yard capacity will be employed after 1976. The various equipment needs for the proposed surface mining operations are given in Table 4.

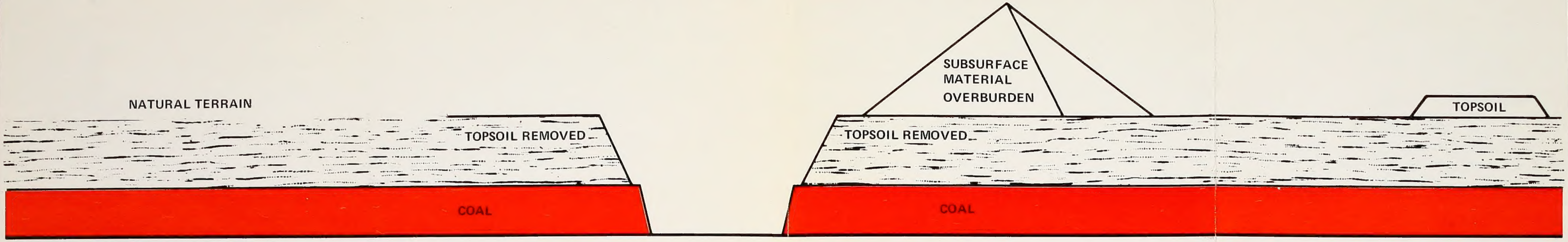
Overburden materials are deposited in different locations depending upon whether it is removed from the first cut



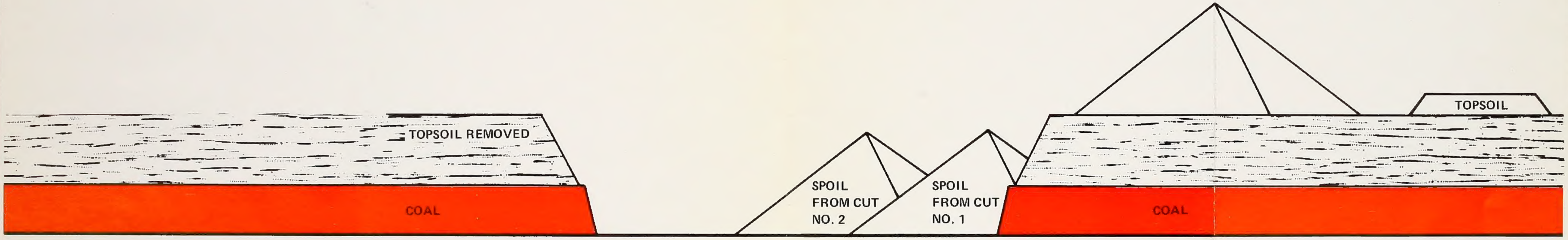
LEASE BOUNDARIES AND SURFACE OWNERSHIP
COLOWYO MINE COMPANY PROPERTY

SOURCE: W. R. GRACE & CO.

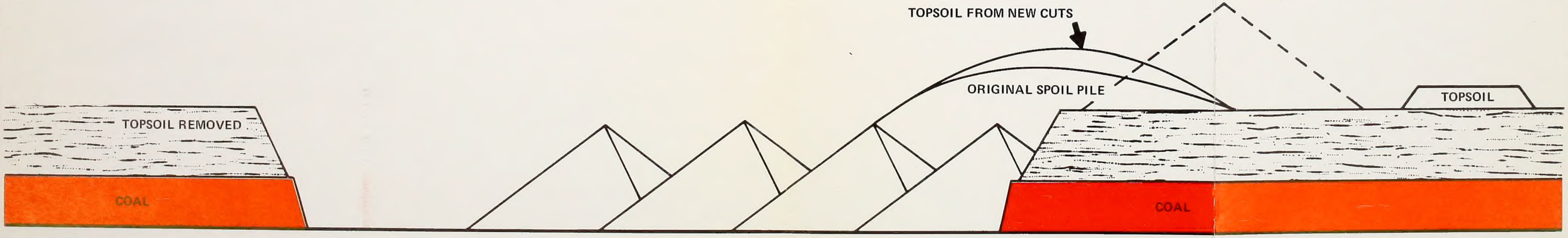
FIGURE 3



INITIAL BOX CUT



ORIGINAL BOX CUT PLUS TWO CUTS



FIVE CUTS PLUS INITIAL RECLAMATION

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SCHEMATIC CROSS SECTIONS OF INITIAL AND SUCCESSIVE BOX CUTS AND RECLAMATION PROCEDURES

Source: VTN

FIGURE 4

B
BUCYRUS-ERIE COMPANY
E
GRACE
AGRICULTURAL PRODUCTS

TABLE 4

ESTIMATED EQUIPMENT FOR OPERATIONS OF TAYLOR CREEK MINE FOR PHASE I AND PHASE II

Surface Mine	Phase I No. of Units or Dimensions	Phase II No. of Units Added
Overburden Drill	1–9″	2–9″
Coal Drill	1–2″	2–2″
Dragline	1 x 28 x 195	1–40 x 285 1–8 x 120
Cable Reel	1	1
Coal Loader	1–22 cu. yd.	
Front End Loader	2–10 cu. yd.	2
Coal Hauler off Highway	2–100 ton	10
Coal Hauler on Highway	13–26 ton	
Skidder	1–120 Hp	1–120 HP
Crawler Bulldozer	2–385 Hp	2–385 Hp
Wheeled Bulldozer	1–400 Hp	1–400 Hp
Grader	1–150 Hp	1–225 Hp
Mobile Crane	1–50 ton	
Heavy Service Vehicles	5	3
Light Service Vehicles	5	5
Pit Switchhouse	2	2
Move Power Line	8,300′	
Construct Power Line	8,400′	6,200′
Substation	2	1
Pumping System	2	2
Lighting System	23,000′	6,200′
Communication System	6	6
Explosives Magazine	2	2
Man Shelter	1–15′ x 18′ x 10′	1–15′ x 18′ x 10′
Haul Road	11,400′ x 42′	
Exploration	5,000′ x 2″	5,000′ x 2″

3,000,000 tons coal per annum
15,700,000 bank cubic yards overburden per annum

Mine Buildings	Case I No. of Units or Dimensions	Case II No. of Units Added
Office and Furniture	2,560 s.f.	
Shop and Warehouse	9,000 s.f.	
Shop Equipment		
Garage	353,600 c.f.	2 bays
Sanitary Facilities		
Site Preparation		
Crushing and Loading Facilities, Colowyo and Craig		
Truck Bridge	1	1
Tunnel Liner	1	1
Feeder	1	1
Conveyors	1	1
Hammermill	650 tph	1
Conveyors	1	1
Hopper	1	1
Conveyors		1
Chutes		
Housing and Galleries		
Sampling Station		1
Laboratory and Equipment		
Lighting System		1
Access and Service Roads		
Site Preparation		1
Storage Silo		2
Loading Facility		

Source: Colowyo Mine Company; a division of W. R. Grace & Co.

(box cut) or successive cuts (See figure 4). Overburden material from the box cut is stored in "spoil piles" while material from successive cuts is deposited in the spaces left from the preceeding cut. The initial phase of the reclamation plan will use the original above ground spoil pile to backfill between the subsurface spoil piles as shown in Figure 4. The coal seams are also blasted, the coal loaded by a 22 cubic yard shovel into 100 ton capacity trucks and transported from the working face to a 100 ton truck dump and crusher adjacent to the mining area.

By the present economics, four coal seams are considered potentially strippable and are delineated in Figure 5 as the x,y, A and B seams. The mining sequence is illustrated in Figure 6, The Colowyo Coal Company plans to remove approximately 3,000,000 cubic yards of topsoil and approximately 186,000,000 cubic yards of overburden which consists of sandstone, carbonaceous shale and shaley sandstone. It is estimated that approximately 35,000,000 tons of coal will ultimately be removed from these four seams, representing 95 percent of the strippable reserves. Present plans for future development and mining of deeper coal seams call for utilizing standard underground mining methods.

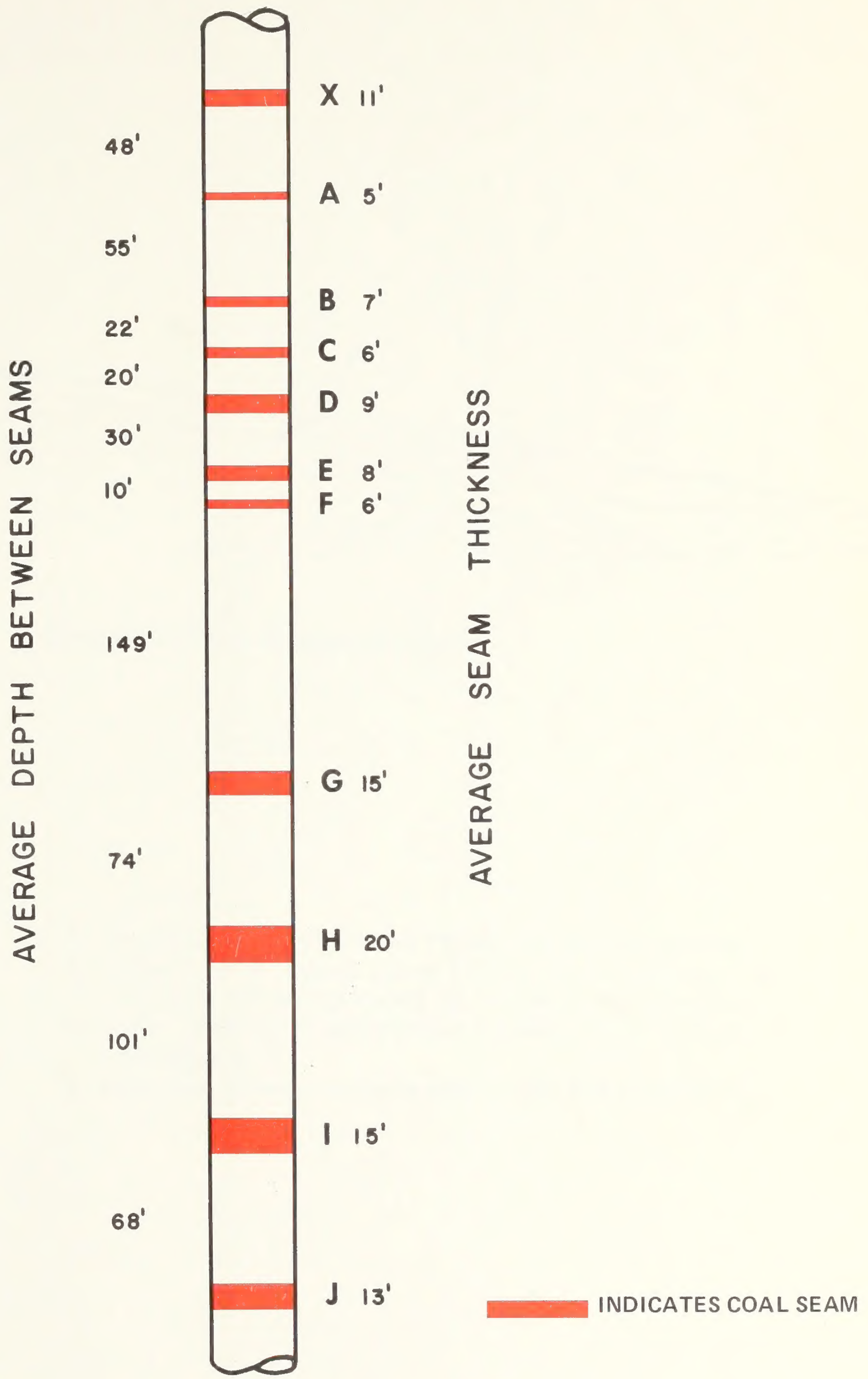
3. YEARLY PRODUCTION RATES AND PHASING

The proposed operations are projected to consist of two major phases. Phase I is projected to begin in the third quarter of 1975. The initial projected annual production rates are listed as follows:

1975	1st year	305,000 tons of coal
1976	2nd year	620,000 tons of coal
1977	3rd year	900,000 tons of coal
1978	4th year	1,250,000 tons of coal

Coal extraction will begin on the west side of the east branch of Taylor Creek southward in Section 4, Township 2N, Range 93W. This will be the only place in coal production during the first year of operation. Mining operations will begin on the west branch of Taylor Creek during the second year. Coal extraction will be completed on the west branch of Taylor Creek after the fourth year. After the completion of Phase I, this area will be reclaimed and revegetated to support grazing and range wildlife.

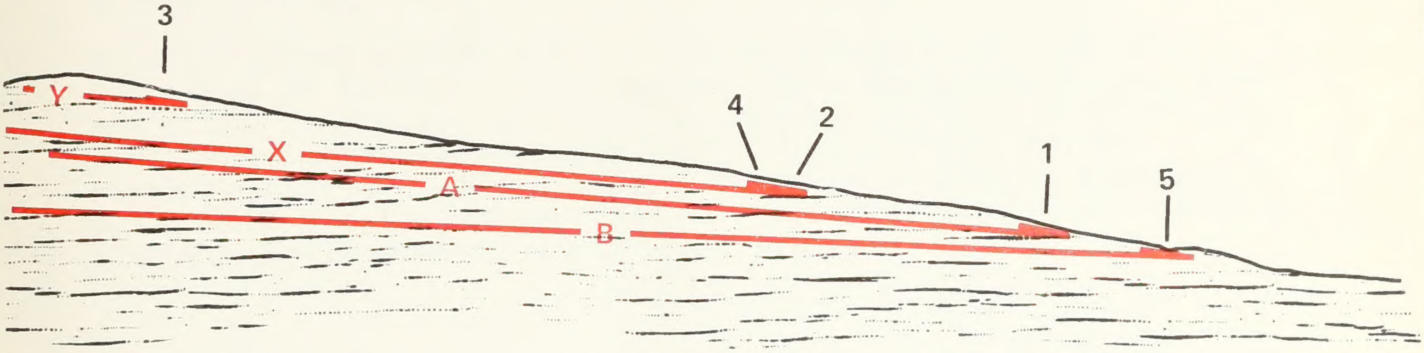
Phase II of the production plan begins in the fifth year, 1979. At this time the mine will have reached its projected production capacity of 3,000,000 tons per year. This production rate is expected to continue for eleven consecutive years or until 1990. During the 15 year life of the surface coal extraction



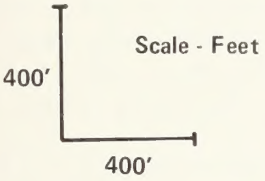
STRATIGRAPHY RECORD (TYPICAL SECTION)

SOURCE: PAUL WEIR COMPANY

FIGURE 5



Looking West - Generalized Cross Section



1. First, mine "A" seam to a bench 120 feet wide by 5,000 feet long.
2. Second, mine "X" seam to a bench 120 feet wide by 5,000 feet long.
3. Third, mine "Y" seam to a bench 120 feet wide by 5,000 feet long.
4. Fourth, return to "X" seam and mine to a bench 200 feet wide by 5,000 feet long.
5. Fifth, mine "B" seam to a bench 120 feet wide by 5,000 feet long.

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COLOWYO SURFACE MINING SEQUENCE

SOURCE: GATES ENGINEERING

FIGURE 6

the stripping ratio of coal to overburden will average 5.4:1. Production during year 5 through 15 will generally be moving from west to east as the area designation indicates on Figure 7 (see Region 1, 2 through 7). Beyond the year 1990, coal production at the Colowyo Mine will most likely be by underground methods (see Figure 7). Presently there exist 10 more mineable seams listed by alphabetical letters as C, D, E, etc. There is an estimated potential in these lower seams of a minimum of 127.5 millions tons of coal recoverable by underground mining methods.

Both the phasing plan and the yearly production rates are described on Table 5. Development of underground mining plans are still in process and will be considered as a separate project; and therefore is beyond the scope of this report. Further details of the mining plan are included in Appendix A, along with the USGS guidelines for the preparation of a Mining Plan for Environmental Impact Statement.

4. PROCESSING

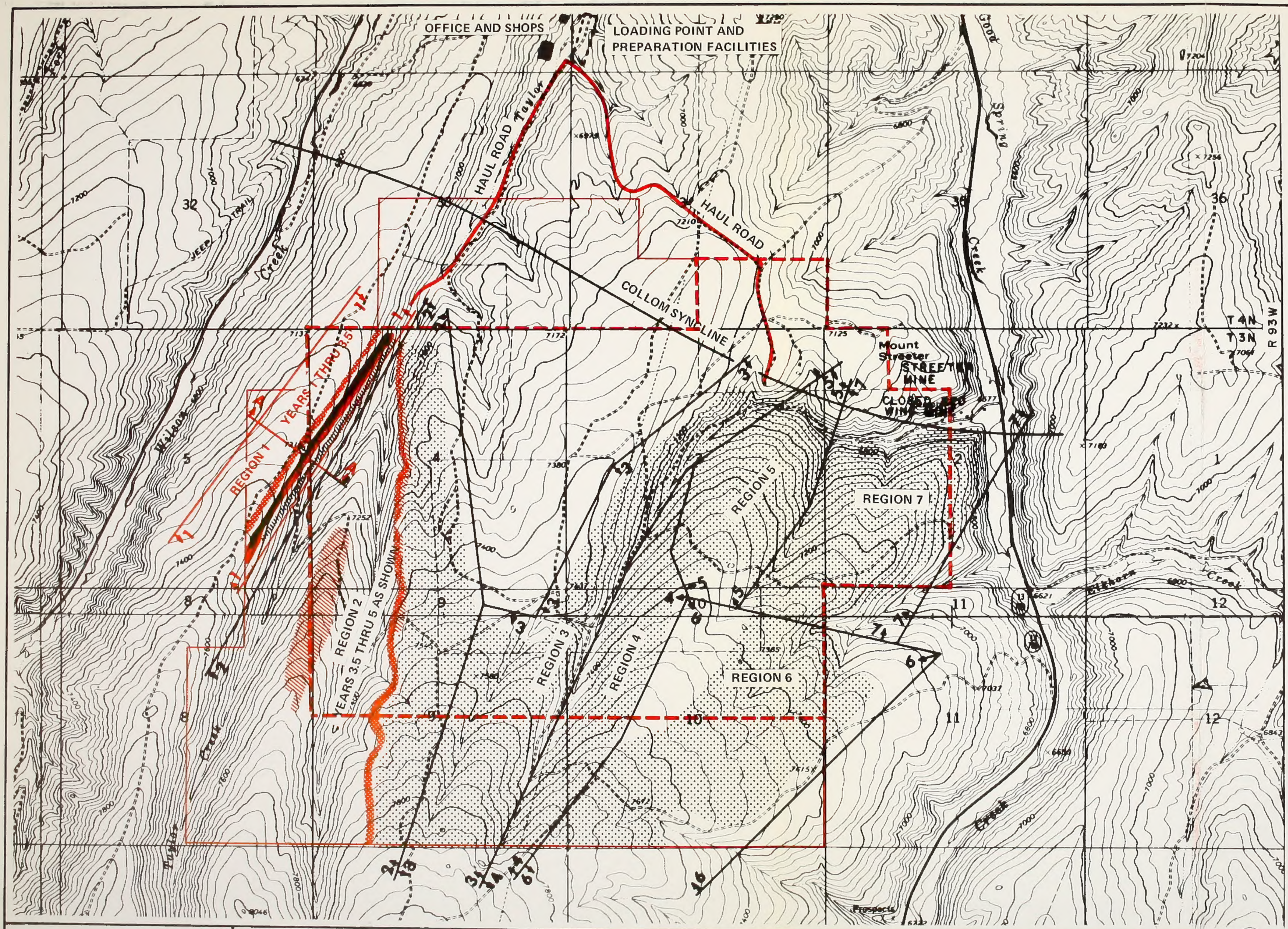
Crushing, Conveying, Loading and Transport

The processing of the coal is limited to primary and secondary crushers (hammermill-type) which reduce the coal to a size to suit the specifications of the customer. Present plans call for a coal product of an approximate 1.5-inch maximum size.

High speed belt conveyors transport the coal from the primary crusher through the secondary crusher and to the top of the storage facility. These facilities are planned to have a capability of 24,000 tons. During the initial mining phase, the coal will be transferred by front end loaders into 30 ton capacity trucks and will be initially hauled 26 miles to a coal loading facility in Craig, Colorado. This facility is located on the east-west rail line of the Denver and Rio Grande Western (D&RGW) Railroad. Eventually, the coal will be hauled to a new location on the D&RGW spur being constructed to the new Colorado-Ute power plant seven miles south of Craig, Colorado.

5. SAFETY

The Colowyo mining operation is governed by various Federal, State, and company regulations designed to safeguard against accidents or other safety hazards on the site. These standards include the following:



NORTH

SCALE: 1" = 2000'

LEGEND

MINING PERIOD

▨ 1975 OR YEAR 1

🟥 1976

■ 1977

🟥 1978

▨ 1979

☐ SUBSEQUENT TO 1979

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SURFACE MINING PLAN
COLOWYO MINE
AXIAL BASIN, MOFFAT COUNTY, COLORADO
SOURCE: W. R. GRACE & CO.

FIGURE 7

TABLE 5

PHASING PLAN & YEARLY COAL PRODUCTION RATES COLOWYO COAL MINE

		Tons of Coal Produced				Annual Reclamation (Acres)		
Year of Life	Target Year	Truck	Other Coal Transport System	Surface Acres	Length of Cut 120 Feet Wide	Graded	Topsoil	
1st	1975	305,000		15.3	5,600 Feet	0	0	Loadout facility completed. Initial coal trucked to railhead.
2nd	1976	620,000		31.2	11,300 Feet	0	0	Trucking coal to railhead at Step I plan.
3rd	1977	900,000		45.3	16,400 Feet	36.7	0	Coal transport system under construction. Reclamation begun.
4th	1978	125,000	1,075,000	60.4	21,900 Feet	20.4	40.0	Trucking phased out. Step II plan initiated.
5th	1979		3,000,000	150.9	54,800 Feet	150.0	150.0	Step II plan in force. Projection rate achieved.
6th	1980		3,000,000	150.9	54,800 Feet	150.0	150.0	Colowyo settled into 10 straight years of balanced production.
7th	1981		3,000,000	150.9	54,800 Feet	150.0	150.0	Detailed future underground mining planned.
8th	1982		3,000,000	150.9	54,800 Feet	150.0	150.0	
9th	1983		3,000,000	150.9	54,800 Feet	150.0	150.0	
10th	1984		3,000,000	150.9	54,800 Feet	150.0	150.0	
11th	1985		3,000,000	150.9	54,800 Feet	150.0	150.0	
12th	1986		3,000,000	150.9	54,800 Feet	150.0	150.0	
13th	1987		3,000,000	150.9	54,800 Feet	150.0	150.0	
14th	1988		3,000,000	150.9	54,800 Feet	150.0	150.0	
15th	1989		2,548,000	168.8	61,274 Feet	170.0	200.0	Surface coal extraction phased out. Underground mine phased at continuous 3,000,000 tons per year rate.
16th	1990					102.9	96.0	Total projected surface reclamation completed.
						*100.0	*100.0	*100 acres utilized for service and haul roads and topsoil inventory storage.

Source: Colowyo Mine Company; a division of W. R. Grace & Co.

a) Coal Mine Health and Safety Act, administered by the Mine Enforcement Safety Administration: Title 30, Code of Federal Regulations.

b) Commerce and Explosives Act, administered by the U. S. Treasury Department: Part 181 of Title 186, Code of Regulations.

c) Mining Laws of the State of Colorado, administered by the State Division of Mines: Colorado Revised Coal Mining Statutes 1963: Chapter 92, Articles 1-12.

As described in the following paragraphs, several safety hazards exist which are inherent to any surface mining operation. In each case, appropriate measures have been or will be taken to reduce or eliminate the potential hazard, as required by the above standards and additional guidelines and company policies.

Traffic control provides a major example of comprehensive safety planning. All traffic enters the mining site by means of an access road leading from Colorado Highway 13 which connects the cities of Meeker and Craig, Colorado. Safeguards will be adopted in controlling traffic on haulage roads within the mining area. Haulage roads will be constructed to a maximum four percent grade for safety during winter weather conditions. All trucks will be equipped with backup alarms which automatically sound whenever the vehicles move backward. Traffic flow patterns will be established each day to serve the areas mined, and all drivers will be thoroughly briefed before beginning work. All employees will receive additional training after being hired by the company, in which the importance of adhering to safety procedures will be stressed.

Colowyo will closely follow regulations governing blasting and storage established by the U. S. Bureau of Mines and the Department of the Treasury.

Similar precautions will be followed to insure personnel safety in other mining and processing areas. Dust resulting from mining operations and truck traffic will be reduced by watering of coal loading and haul roads which are in continuous use during working hours. In compliance with Federal regulations, dust exposure for all personnel will be monitored and samples will be sent to the Bureau of Mines for analysis.

Methane gas, which may be released during loading procedures, will be controlled by a methane monitoring system and by ventilation fans under the storage facilities. Employees will be required to wear protective devices, such as safety glasses and ear plugs. Noise levels will also be reduced by installation of heavy-duty mufflers on all trucks and by housing the crushers and conveyors.

Numerous mechanical devices will be utilized to prevent injury, including emergency stop cables on the high-speed conveyors and 30-second startup alarms for processing and tipple loading operation.

Public Safety will be protected by fencing along the entire perimeter of the site and by 24-hour security patrols. Safety, first aid training, and emergency room space will be provided at the site. All health and safety programs will be established, implemented and monitored under the direction of a safety engineer who will report to the General Manager.

6. WATER SUPPLY

In addition to the following discussion of water management, the water resources of the mine area are described in Section IV, Drainage Patterns and Ground Water, and the impacts of the mine on water resources are discussed in Section V.

Three principal sources of water will be utilized to supply the water demands of the mining operation and also domestic demands. The main source of water will be supplied by surface water diverted from Wilson Creek. Water rights have been secured by the company for a maximum withdrawal of 5 cfs from Wilson Creek. Some of the water pumped from Wilson Creek will be stored in an elevated tank and will be used for potable water, toilets, showers and other activities that require a high quality water. The remainder of the Wilson Creek water supply will be used to augment on site water sources which will be used for dust control and any other mining operation that requires water.

The second supply source will be water that collects in the scraper pits developed during the dragline operations. This water will flow from shallow aquifers that have been intersected and exposed during stripping operations. Some surface runoff during heavy rainfall and during snow pack melting can also be expected to reach the scraper pits. A system of swales will be constructed in and around the scraper pits to collect and transport this water to a sump for pumping to a series of settling ponds located above the Taylor Creek flood plain. The clarified water from the final settling pond will be a primary source of water for dust control, revegetation and other water consuming operations. Clarified water from the final settling pond would be channeled into a storage pond. Overflow from this storage pond will be directed back into Taylor Creek downstream from the area of the mining operations.

The third source of water at the site will be that water developed from the underground mining operations. This water will be pumped from the underground mine to the settling pond for storage. The amount of water supplied by seepage into the underground operations is uncertain, but the quality of the water is expected to be similar to surface waters in the area.

7. WASTEWATER AND SOLID WASTE MANAGEMENT

Reuse of on-site water is an effective wastewater pollution control technique in this water scarce region. The underground mine water will be conveyed to the settling ponds along with any water collected in the scraper pits. An overflow channel in the final settling pond will allow the treated water to flow into a storage pond where it could be utilized for revegetation programs and for dust control. The settling pond should remove most of the suspended solids. By regulating the amount of water being drawn from Wilson Creek, a completely controlled water system can be maintained. During periods of heavy runoff, surface runoff will be diverted around the settling ponds and the storage ponds to insure that the water system does not become overloaded. A protective system of shallow berms will be constructed to divert runoff from the mining operation and back into the natural drainage courses.

Sanitary facilities should be constructed to service the initial construction crews and eventually expanded to meet the full contingent of permanent workers (approximately 186 people). Chemical toilets would be installed to handle sanitary waste during the construction period. Soil and percolation tests will be made to determine the best site for construction of a septic tank and drain field system to handle the sanitary wastes when full employment is reached. Design criteria for construction of the sanitary treatment and disposal systems for the Colorado Department of Health will be followed. If soil conditions prove to be unsatisfactory for a septic tank system, it will be necessary to construct a package treatment plant that will achieve at least full secondary treatment. Effluent from this plant would be discharged into Wilson Creek after satisfying all effluent requirements of the Colorado Department of Health. Future EPA guidelines may require that this package treatment plant be upgraded to achieve higher removal efficiencies for BOD, nutrients or suspended solids.

Solid waste disposal will be accomplished using standard methods for landfill disposal as outlined by the State of Colorado waste disposal regulations. It is expected that suitable landfill sites will be identified on the lease property which will be acceptable to the State of Colorado and the U. S. Bureau of Land Management (BLM).

E. LAND RECLAMATION

Objectives

At present, the land in and around the Colowyo Coal Company property is used mainly for recreational and agricultural purposes. Ranchers graze the land with domesticated sheep and cattle, while mule deer and elk seasonally habitat the area. The reclamation effort will restore or upgrade the existing grazing characteristics of the land. Reclamation plans for all mining projects are under the specific jurisdiction of the Colorado Open Mining Land Reclamation Act of July, 1973. Reclamation Research applicable to the proposed project site is discussed in Appendix A.

Proposed Reclamation Plans

The land reclamation work at the Colowyo Mine will commence immediately with the start of the proposed project. The process will involve a number of stages beginning with the vegetation being removed by a brush rake attached to a bulldozer. The plants will be shredded and mixed with the topsoil (which is the first one inch). This should increase the humus and general organic characteristics in the soil. During the life of the mine, Colowyo expects to move approximately 3,000,000 cubic yards of topsoil. Once the vegetation and topsoil have been shredded, loosened, and transported to holding areas, the material will be contoured to follow the general slope of the land for the purposes of slope stability and erosion control.

The preferred storage location will be located parallel to the natural slope. After contouring by bulldozers is completed, the topsoil will be mulched, seeded, fertilized, and compacted to assure against erosion. Fast growing grasses and legumes that are suited to the region's climate and soil will be used primarily for this purpose. The storage piles will appear as long mounded terraces contoured along the natural slope.

After topsoil removal and storage, the overburden will be removed by the drag line and stockpiled in the preceding box cut (see Figure 4). The overburden will be replaced into the mining pit after the coal is removed and the previously stored topsoil used as covering. Contouring should return the landscape into a somewhat lower profile than previously existed because of the removal of the coal mass. According to the mining schedule, visable evidence of the land reclamation and revegetation program should become visable during the third

year of operation. The total time elapsed between topsoil removal to storage and replacement and reseeding, however, should be approximately six years for each extraction area. This is based on the plan of one year for topsoil and site preparation, three years for overburden and coal extraction, one year for overburden smoothing, and one year for topsoil replacement and seeding. During the final reclamation processes, various government and state agencies (the Bureau of Land Management, Soil Conservation Service, etc.) will be invited to monitor and assist in the success of the plan, as required by the Colorado Open Mining Land Reclamation Act.

F. MONITORING PROGRAM

Appendix D contains a description of the proposed continuous water quality and meterological baseline monitoring program for the Colowyo Coal Mine. The U. S. Geological Survey and the Bureau of Reclamation have also designated the Colowyo Mine Company property as a study area to assess land reclamation potential. The proposed monitoring program has been designed to augment the USGS and Bureau of Reclamation program such that both data sources can be combined and analysed to give a good basis of data to be used in assessing impacts and mitigating potential problems.

DESCRIPTION OF THE REGIONAL AND LOCAL ENVIRONMENT

IV. DESCRIPTION OF THE REGIONAL AND LOCAL ENVIRONMENT

A. THE PHYSICAL ENVIRONMENT

1. PHYSIOGRAPHY AND LANDFORMS

The proposed mining area is located on the south flank of the Axial Basin uplift which forms the southern portion of the Wyoming Basin physiographic province as shown in Figure 8. This province is typified by plateaus and mesas, isolated mountain ranges, and bordering steep mountain slopes.

Topographically the specific area investigated is characterized by gently northerly-sloping mesas (360± feet/mile) with surface elevations ranging from 7000 to 7600 feet above sea level. These mesas have been incised by ephemeral and intermittent streams forming relatively steep bluffs along the mesa flanks, particularly along Taylor and Good Spring Creeks as shown in Figure 9. Maximum relief between mesa surface and stream valley floor is approximately 320 feet in the vicinity of the closed Red Wing Mine. Associated maximum slope gradient is about 64 percent.

Drainage courses of the ephemeral and intermittent streams on the site and immediate vicinity are subparallel and flow perpendicular to the regional strike of geologic units. It appears that this pattern is controlled by two major factors: 1) a system of subparallel joints in rock units (Hancock, 1914) which have created zones of weakness in the mesa capping sandstone beds, thus allowing more rapid erosion by streams; and 2) similarly oriented local folds producing a series of hogback ridges. These elongate stream channels are of economic importance to the region as they provide access to the Yampa River Valley, a main transportation route, and cut across and expose considerable portions of coal bearing units (Hancock, 1925).

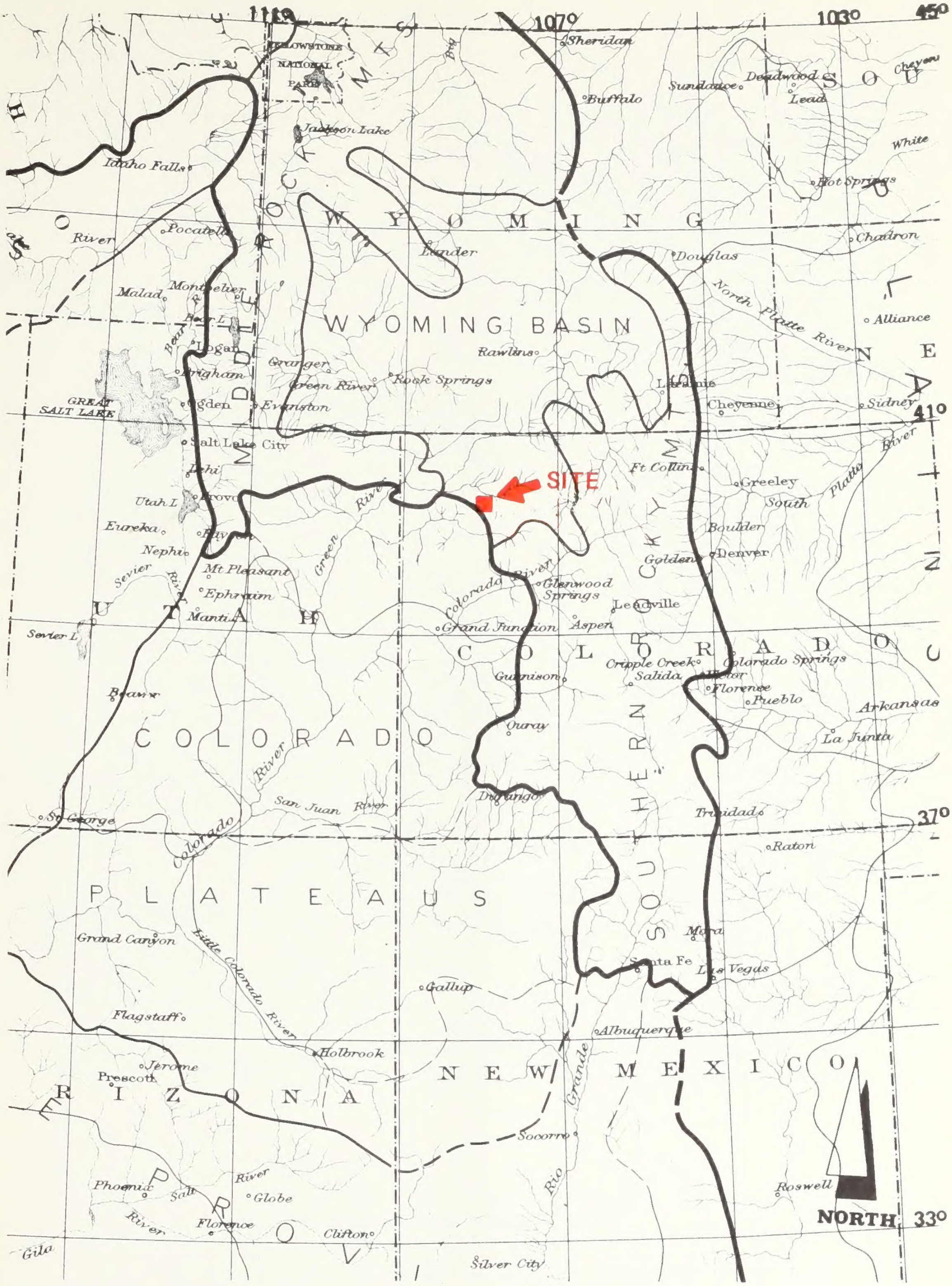
2. GEOLOGY

Stratigraphy

The site is underlain by as much as 13,500 feet of sedimentary rock consisting of approximately 4500 feet of Paleozoic (570 million to 225 million years in age) quartzite, limestone, shale, sandstone, and gypsum; and 9000 feet of Mesozoic (225 million to 70 million years in age) limestone, shale, mudstone, sandstone, and conglomerate as shown in Figure 10. Economically important coal beds are found in the upper portions of the Mesozoic formations.

NORTH SLOPE LANDSCAPE

IMMEDIATE AND DISTANT MESA TOPS



APPROXIMATE SCALE: 1 INCH = 110 MILES

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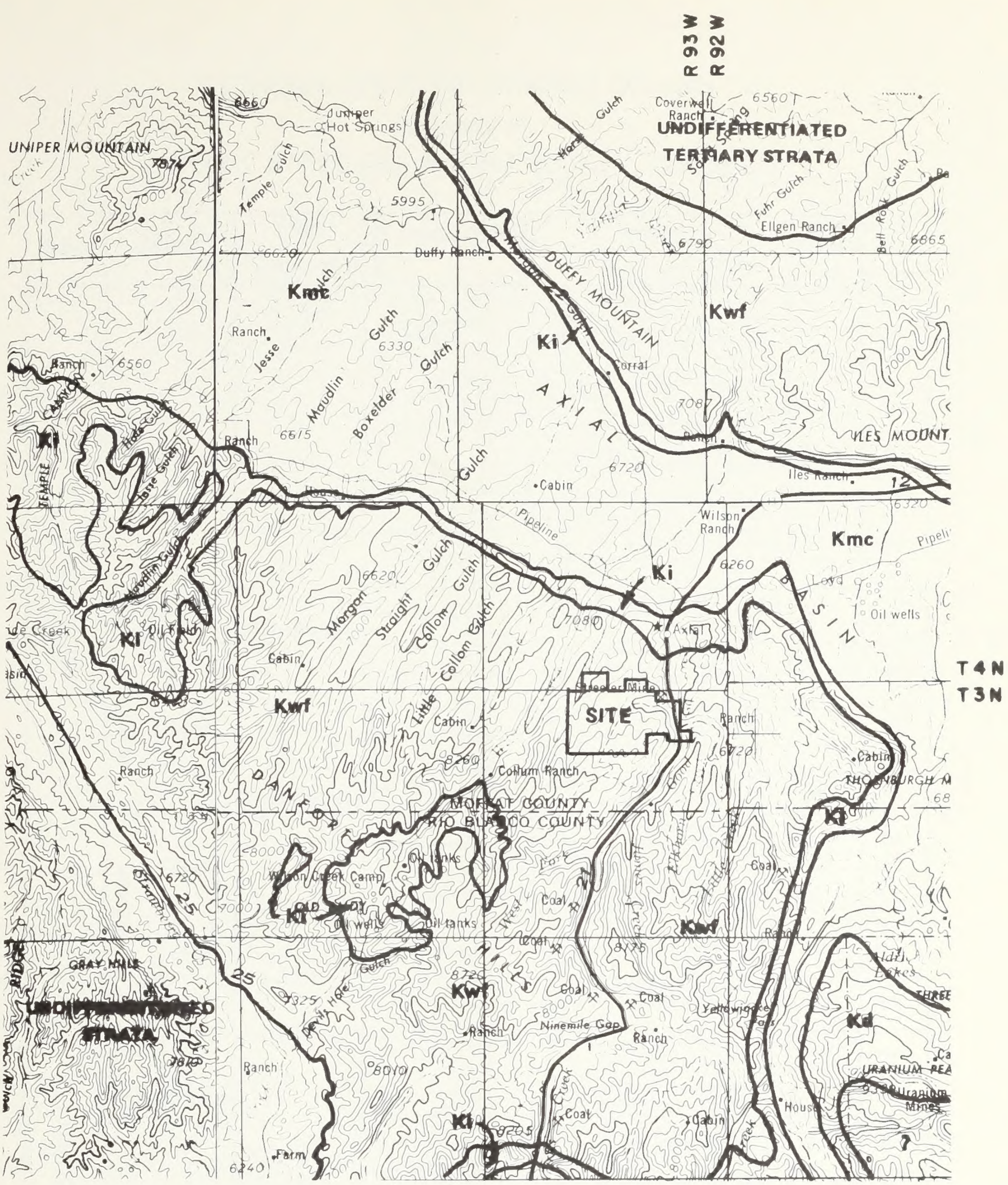
REGIONAL PHYSIOGRAPHIC MAP

SOURCE: USGS, MAP OF PHYSIOGRAPHIC PROVINCES OF UNITED STATES, 1971

FIGURE 8



LEGEND

CRETACEOUS

Kwf	WILLIAMS FORK FORMATION
Ki	ILES FORMATION
Kmc	MANCOS SHALE
Kd	DAKOTA SANDSTONE

SCALE 1 inch = 4 miles

NORTH

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REGIONAL GEOLOGIC MAP

SOURCE: USGS, HOYT, 1907

FIGURE 9

GENERALIZED STRATIGRAPHIC COLUMN
in vicinity of
MOUNT STREETER, MOFFAT COUNTY, COLORADO

ERA	PERIOD	TIME ($\times 10^6$ yrs ago)	GROUP	FORMATION	MEMBER	SUMMARY LITHOLOGIC DESCRIPTION	APPROXIMATE THICKNESS IN FEET UNIT	APPROXIMATE THICKNESS IN FEET CUMULATIVE
		70						
MESOZOIC	Cretaceous Upper		Mesa Verde Group	Williams Fork Formation		Alternating sandstone, sandy shale, carbonaceous shale, and coal beds; characterized by brick-red color.	1000	1000
				Iles Formation	Trout Creek SS member	Sandstone, white, fine-grained, well sorted, massive, fairly uniform in thickness.	100	1100
						Alternating beds of massive sandstone and sandy or carbonaceous shale; light brown to white, poorly sorted, generally calcareous, grades into coal.	1300	2400
				Mancos Shale		Clay shale; soft dark-gray to drab, with lenses and interbeds of sandstone as much as 75 feet thick. Basal unit of bluish and dark-gray slaty shale and calcareous sandstone.	5600	8000
		unconformity		Dakota Sandstone (?)		Quartzitic sandstone; thinly banded greenish-gray, with pebbles at the base.	260	8260
	Jurassic Upper			Morrison Formation		Shale, limestone, chert, conglomerate lenses, and sandstone; green, greenish-gray, varicolored and maroon.	400	8660
			San Rafael Group	Curtis Formation		Shale, glauconite sandstone and thin beds of glauconitic limestone, locally oolitic, thinly-bedded, gray.	40	8700
		unconformity		Entrada Formation		Sandstone; massive beds, fine-grained, sugary, light gray.	400	9100
	Triassic Upper			Chinle Formation		Calcareous shale, mudstone and a few sandstone and limestone pellet conglomerate beds.	350	9450
		unconformity		Shinarump Conglomerate		Sandstone and conglomerate interbedded, lenticular beds and steeply crossbedded, red.	50	9500
	Triassic Lower			Moenkopi Formation		Siltstone, shale; greenish-gray and gray, with thin red colored beds.	600	10100
		225						
PALEOZOIC	Permian			Phosphoria Formation		Calcareous shale to sandstone, limestone, and chert with concretions.	100	10200
		270						
	Pennsylvanian			Weber Sandstone		Calcareous sandstone; massive, light gray to buff, fine-grained.	250	10450
				Maroon Formation		Shale, sandstone, and limestone; red, interbedded.	1150	11600
				Paradox Formation		Gypsum, dark shale, yellow sandstone, red shale and siltstone; thick beds.	650	12250
		unconformity		Morgan Formation		Cherty sandstone, shale and limestone.	1750	14000
	Mississippian			Molas (?)		Basal red shale of Morgan Formation.	50	14050
				Madison Limestone		Cherty dolomitic limestone and dolomite; light and dark gray.	430	14480
	? - ?	350?						
	?	unconformity		Beds of undetermined age		Interbedded shale sandstone, limestone an dolomite.	200	14680
	Cambrian			Sawatch Quartzite		Dolomitic quartzite to quartzose sandstone; dark to very light brown and gray, locally crossbedded.	?	?
		570						

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GENERALIZED STRATIGRAPHIC COLUMN

SOURCES: HANCOCK, 1925; KONISHI, 1959; THOMAS ET AL, 1945; HALLGARTH, 1959

FIGURE 10

All of the Paleozoic and Mesozoic age (Triassic and Jurassic periods) rocks are located in the subsurface in the immediate region surrounding the study area. The nearest outcrop of rocks of this age group is approximately 15 miles south of the site along the White River. Dakota Sandstone and Mancos Shale of upper Cretaceous age outcrop approximately 2 miles north of the subject property as shown in Figures 9 and 10, and are estimated to lie beneath the site at depths of greater than 2100 feet. The geologic units of immediate concern in this study are the upper Cretaceous Iles and Williams Fork Formations of the Mesa Verde group as shown in Figure 10.

Iles Formation: The Iles Formation consists mainly of pale brown to white, fine-to medium-grained, poorly sorted, generally calcareous sandstone with interbedded red and dark maroon, sandy and silty carbonaceous shale which commonly grades into impure coal or is associated with relatively unimportant coal beds (Konishi, 1959). Fenneman and Gale (1906) defined the uppermost sandstone of the Iles Formation as the Trout Creek sandstone member which appears to be a reliable marker horizon at the base of the principle coal beds and consists of white, fine-grained, well sorted, massive sandstone that is fairly uniform in thickness over a large area. The Trout Creek sandstone is a very common ridge-forming unit in the Danforth Hills (Figure 9) and has been called the "White Rock" because of its significant exposures (Gale, 1907).

Stratigraphic thickness of the Iles Formation in the vicinity of the site is estimated to be 1375 feet with the Trout Creek sandstone making up 75 feet of the total (Hancock, 1925). The Iles Formation forms most of the cliffs which surround the Axial Basin. The Trout Creek sandstone member outcrops north of the property about one mile. It appears that the Iles Formation lies at a depth of approximately 1700 feet beneath the subject property; however, minor folds or faults in the regional trend could bring the formation nearer to the surface. Most of the coal beds within the Iles Formation are not of economic importance in the Axial quadrange (Hancock, 1925).

Williams Fork Formation: The Williams Fork Formation consists of alternating beds of sandstone, sandy shale, and coal. It is distinguished from the Iles Formation by its thick zones of brick-red sandstone and shale that have been colored from the burning of adjacent coal beds, an extensive occurrence in the Axial area. Distribution of the coal beds throughout the formation is uniform in the vicinity of the proposed mine, but varies greatly throughout the regional extent of the unit (Hancock, 1925).

Stratigraphic thickness of the Williams Fork Formation in the vicinity of the site has been estimated from structure sections

to be 1600 feet (Hancock, 1925) and its areal extent in the Axial Basin is similar to that of the Iles Formation.

The Williams Fork Formation is the predominant coal bearing formation in the Mesa Verde group. Mesa Verde coals associated with the Fairfield group, which is the name assigned the coal bearing zone above the Trout Creek sandstone (Gale, 1907), rank in quality about midway between bituminous and subbituminous (Hancock, 1925). Analyses of untreated samples from the Red Wing Mine and reported by Hancock (1925), indicated the following ranges: moisture, 10.2 to 11.9 percent; volatile material, 38.0 to 40.6 percent; fixed carbon, 45.3 to 49.2 percent; ash, 2.2 to 2.8 percent; sulfur, 0.2 to 0.32 percent; and heating value, 11,610 to 11,830 BTU (British Thermal Units).

Hancock measured several sections in the Williams Fork Formation in the vicinity of the Red Wing Mine and along Good Spring Creek, and found coal beds measured from 4 inches to 13 feet 9 inches thick. A 27-foot thick bed was reported by Gale (1906) and the seam in the Red Wing Mine is as thick as 27 feet (oral communication, Charles Farrington, mine superintendent, 1974). Drillhole data shows four coal seams within 140 feet of the surface with a cumulative thickness of 28 feet which establishes a coal reserve of 35.5 million tons recoverable by surface mining methods. Drillhole logs reveal that other seams are located at depths of 200 feet or more. Several of these seams are as thick as 24 feet.

Prominent features formed by the selective erosion of the Williams Fork Formation that lie within the limits of the proposed mining operation area are the bluffs along Taylor Creek, Good Spring Creek, and the tributary to Good Spring Creek that passes the Colowyo Mine property. At this time the only apparent geologic importance of this formation is the coal.

Structure

The site region is dominated by the Axial Basin anticline or arch, a southeastward extension of the larger Uinta Mountain arch as shown in Figure 12. The Axial Basin anticline is an asymmetrical fold, the axis of which trends north 60 degrees west, with strata dipping (inclining) steeper on the south side of the axis than on the north. The south flank of the anticline has several secondary folds trending subparallel and at approximate right angles to the main anticlinal axis; Figure 11 . In general, the rocks of the broad anticline have not been stressed sufficiently to cause them to be severely broken. A few discontinuous normal faults and some minor thrust faults have been observed in the region (Hancock, 1925) trending primarily parallel to the anticlinal axis.

Structurally, the proposed mining site is relatively simple. The axis of the Collom syncline, a downward fold (Hancock, 1925), passes through the northern portion of the site; Figure 11. Bedding geometry, as measured on surface outcrops, varies about an east-west strike and is characterized by dips from the horizontal of three to twenty degrees northerly over most of the site. Local deviations in this general trend are the result of discontinuous minor folds at various locations.

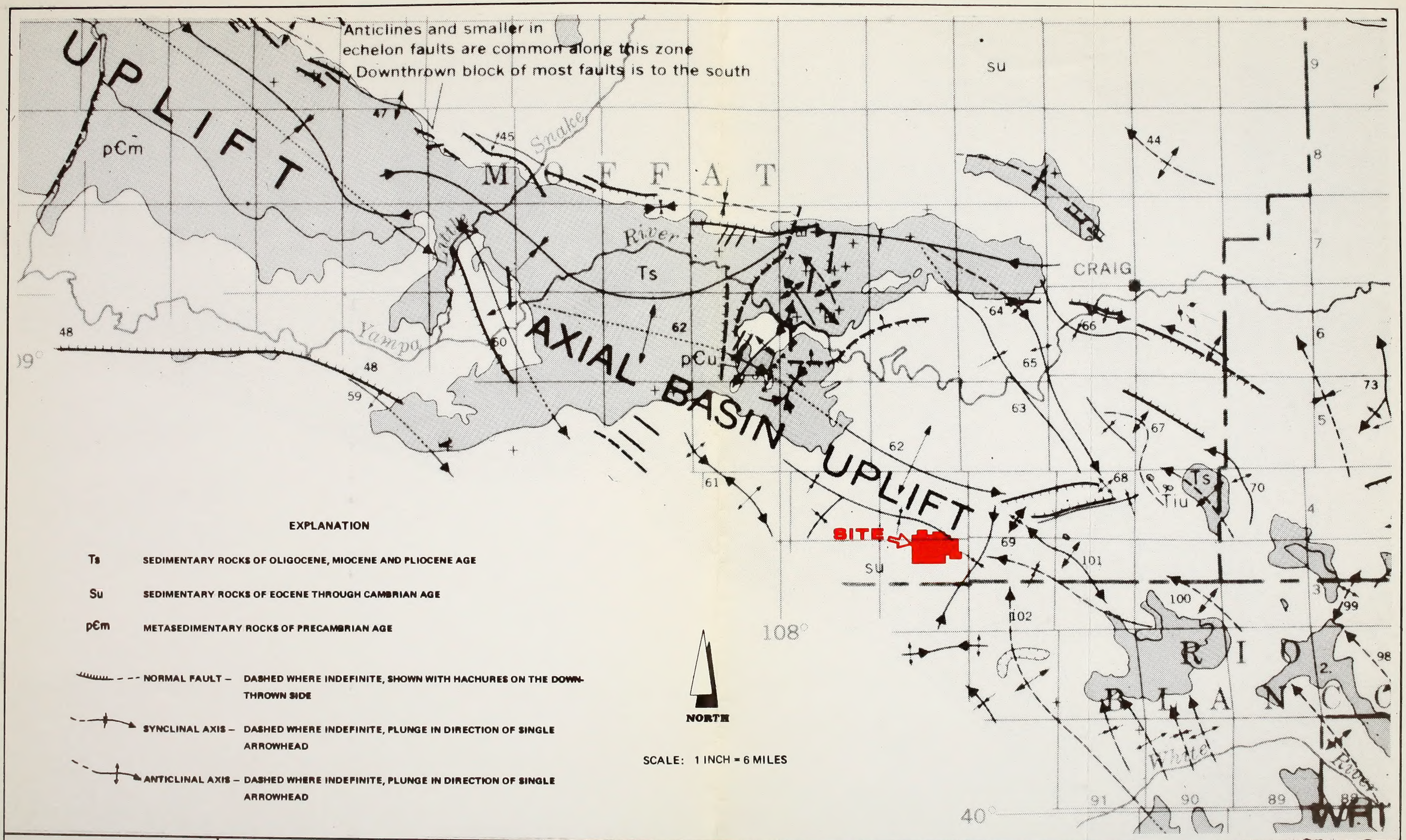
Faulting of the rock units within the limits of the property was not observed during the reconnaissance geologic mapping associated with this investigation; however, some linear features, which may be fault controlled, were observed on aerial photographs of the property (USGS, 1962). Such lineations may also be related to joints (fractures without appreciable movement) in the rock. Three major joint trends that generally coincide with these lineations were observed on the site. These are near-vertical to vertical and strike approximately north 70 degrees west, north 45 degrees west, and north 30 degrees east.

In surface exposures,sandstone preserves joints more readily than highly oxidized and weathered coal beds; however, both have undergone similar stresses and have developed similar readjustment features that should be apparent in the subsurface.

3. SOILS

Soils in the vicinity of and on the site are referred to as "Soils with moderately dark or dark subsurface horizons" by the United States Department of Agriculture (1969). Soil unit 5.1 (USDA, 1969) has been delineated as the principle soil type developed in areas underlain by the Iles and Williams Fork Formations (the soil contact, between 5.1 and adjoining units, very closely follows the geologic contacts; Figure 13. It is dark gray or gray-brown on the surface with underlying moderately dark to dark horizons. Generally, surface materials are composed of clayey loam or sandy loam, designated Type 1 and 2, respectively on the site soils map; Figure 13. More than 5 percent of the surface soil material is organic matter, and on steep slopes composed of talus and slope wash, coarse fragments from higher bedrock outcrops are scattered over the surface. Subsoils range from sandy clay loam to clay in texture and commonly contain gravel and rock fragments.

The major parts of the site having deep soils, with profiles in excess of four feet deep, and moderately deep soils, as deep as 20 to 40 inches, are delineated on the regional and site soil map; Figure 13.



EXPLANATION

Ts	SEDIMENTARY ROCKS OF OLIGOCENE, MIOCENE AND PLIOCENE AGE
Su	SEDIMENTARY ROCKS OF EOCENE THROUGH CAMBRIAN AGE
pЄm	METASEDIMENTARY ROCKS OF PRECAMBRIAN AGE

NORMAL FAULT – DASHED WHERE INDEFINITE, SHOWN WITH HACHURES ON THE DOWNTHROWN SIDE

SYNCLINAL AXIS – DASHED WHERE INDEFINITE, PLUNGE IN DIRECTION OF SINGLE ARROWHEAD

ANTICLINAL AXIS – DASHED WHERE INDEFINITE, PLUNGE IN DIRECTION OF SINGLE ARROWHEAD

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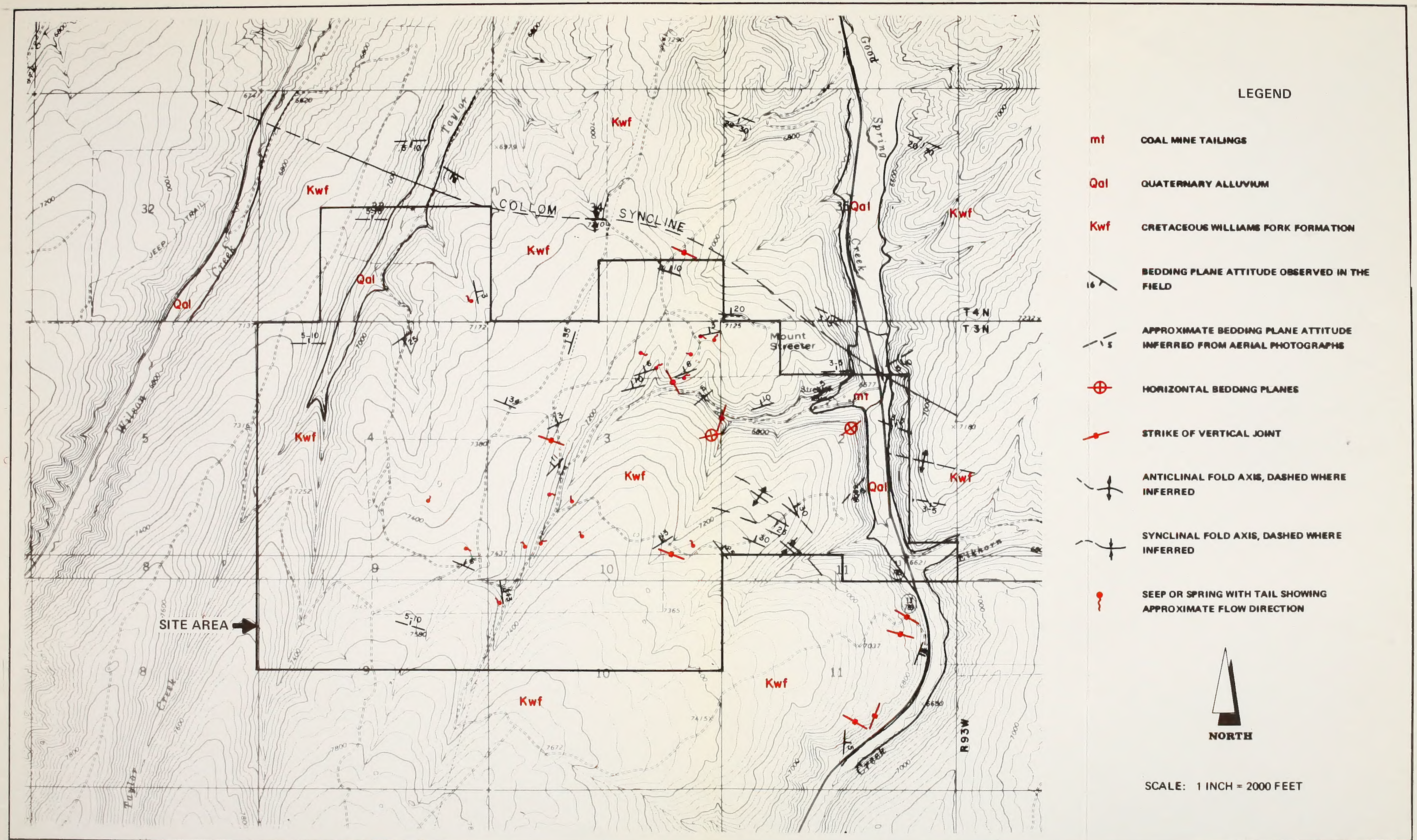
REGIONAL STRUCTURE MAP

SOURCE: OSTERWALD AND DEAN, 1961

FIGURE 11


LEGEND
mt COAL MINE TAILINGS
Qal QUATERNARY ALLUVIUM
Kwf CRETACEOUS WILLIAMS FORK FORMATION
16 BEDDING PLANE ATTITUDE OBSERVED IN THE FIELD
5 APPROXIMATE BEDDING PLANE ATTITUDE INFERRED FROM AERIAL PHOTOGRAPHS
HORIZONTAL BEDDING PLANES
STRIKE OF VERTICAL JOINT
ANTICLINAL FOLD AXIS, DASHED WHERE INFERRED
SYNCLINAL FOLD AXIS, DASHED WHERE INFERRED
SEEP OR SPRING WITH TAIL SHOWING APPROXIMATE FLOW DIRECTION
NORTH
SCALE: 1 INCH = 2000 FEET
COLLOM SYNCLINE
Mount Streeter
Good Spring Creek
Taylor Creek
Wilson Creek
Elkhorn Creek
JEEP TRAIL
SITE AREA
Kwf
Qal
mt
T4N
T3N
R93W
32
33
34
35
4
3
2
5
8
9
10
11

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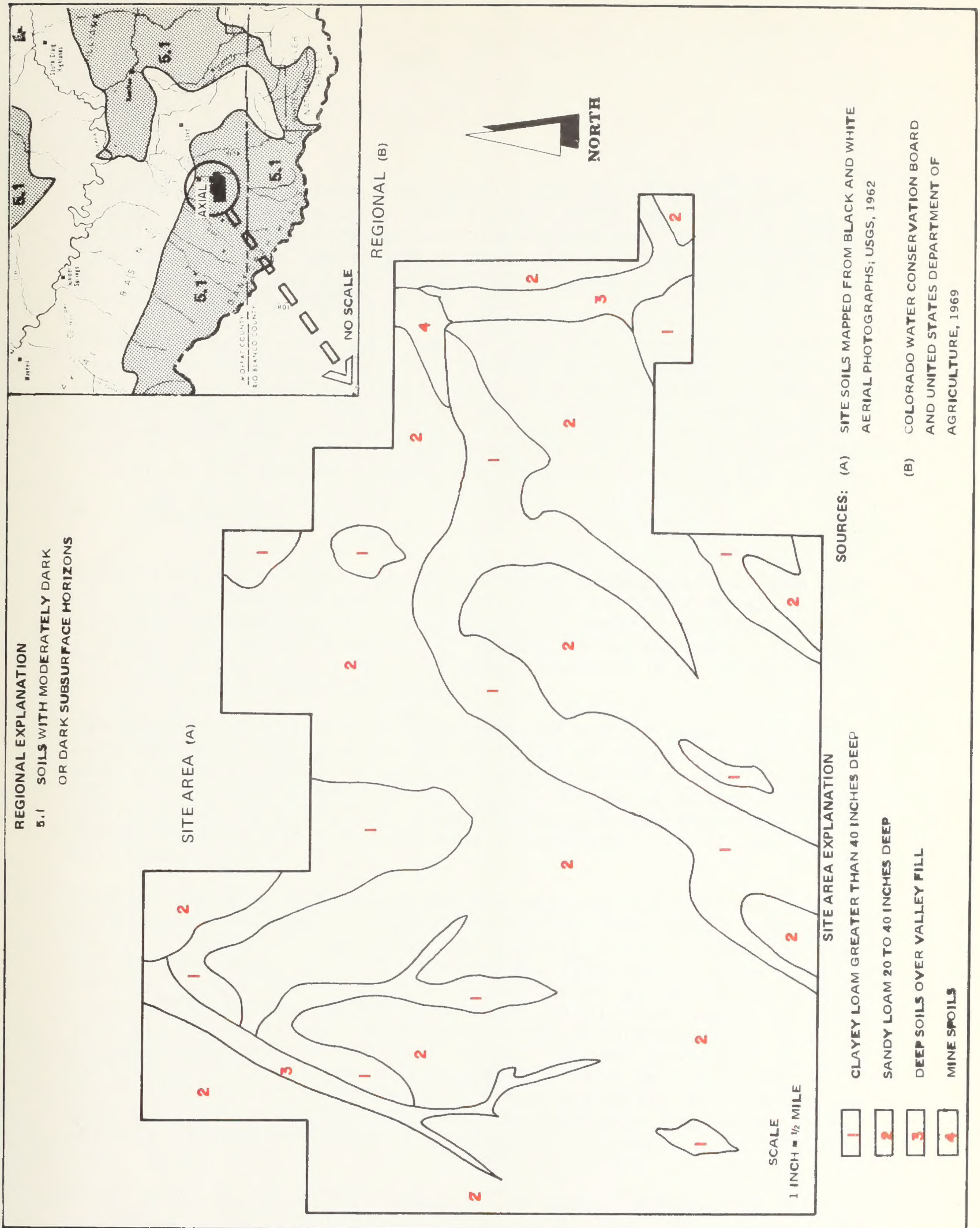
SITE GEOLOGIC MAP

SOURCE: FUGRO, INC., 1974

FIGURE 12



REGIONAL (B)

REGIONAL EXPLANATION

5.1 SOILS WITH MODERATELY DARK OR DARK SUBSURFACE HORIZONS

SITE AREA (A)

SITE AREA EXPLANATION

1 CLAYEY LOAM GREATER THAN 40 INCHES DEEP

2 SANDY LOAM 20 TO 40 INCHES DEEP

3 DEEP SOILS OVER VALLEY FILL

4 MINE SPOILS

SCALE
1 INCH = ½ MILE

SOURCES: (A) SITE SOILS MAPPED FROM BLACK AND WHITE AERIAL PHOTOGRAPHS; USGS, 1962

(B) COLORADO WATER CONSERVATION BOARD AND UNITED STATES DEPARTMENT OF AGRICULTURE, 1969

VTN FUGRO, INC.

REGIONAL AND SITE SOIL MAPS

SOURCES: USGS, 1962; CWCB AND USDA, 1969

FIGURE 13

Deep soils have formed over poorly drained bedrock areas, valley fill, and talus accumulations, while moderately deep soils are underlain by well-drained sandstone or shale bedrock. The dark surface layers may exceed depths of 20 to 30 inches in some locations and lime is usually leached to depths of 40 to 60 inches (USDA, 1969).

Present uses of the soils in the site area primarily support vegetation for domestic stock and wildlife grazing. Soils on the rangeland are subject to gullying, and when tilled become subject to sheet erosion. The USDA (1969) classes the sediment yield from undisturbed soils of this type as low. Due to the clay content, shrink-swell potential may be high and the permeability is relatively low for all of the in-place soils on the site.

4. GROUNDWATER

Very little development of groundwater resources has been done at present in the vicinity of Axial due to the availability of adequate quantities of relatively good quality surface water. Present demands on groundwater appear to be minimal. The few relatively shallow, low yield wells located on or near the site are used for domestic purposes.

The geometry of strata on the proposed mining site, basically a downwarp with its axis on the site, is an important factor in that the water tends to migrate chiefly downdip onto the site area rather than away from the site. Based on field observations, known or potential aquifers beneath the mesas do not appear to have any connection with aquifers beneath the stream valleys.

Several seeps were observed on the site at the time of the reconnaissance. Most of these appeared to be below saturated surficial materials and thus are probably only present during the spring thaw. At this time, water from some of the seeps or springs on the immediate site is collected in stock ponds developed within natural drainage courses to provide water for wildlife and range stock. Some seeps were associated with near surface clinker beds and coal seams. Deeper coal beds do not contain appreciable amounts of water. This is indicated by moisture contents on analyzed untreated samples and conditions that existed in the Red Wing underground mine (Hancock, 1969; Charles Farrington, Colowyo mine superintendent, oral communication, 1974).

Data on the water level, quality, or specific yield of wells in the Axial area is not available at this time. Considering projected plans for construction of a system of dams and canals for domestic and agricultural water supply (USDA & CWCB, 1969), future demands on the local groundwater resources will probably be minimal.

5. SEISMICITY

Regional

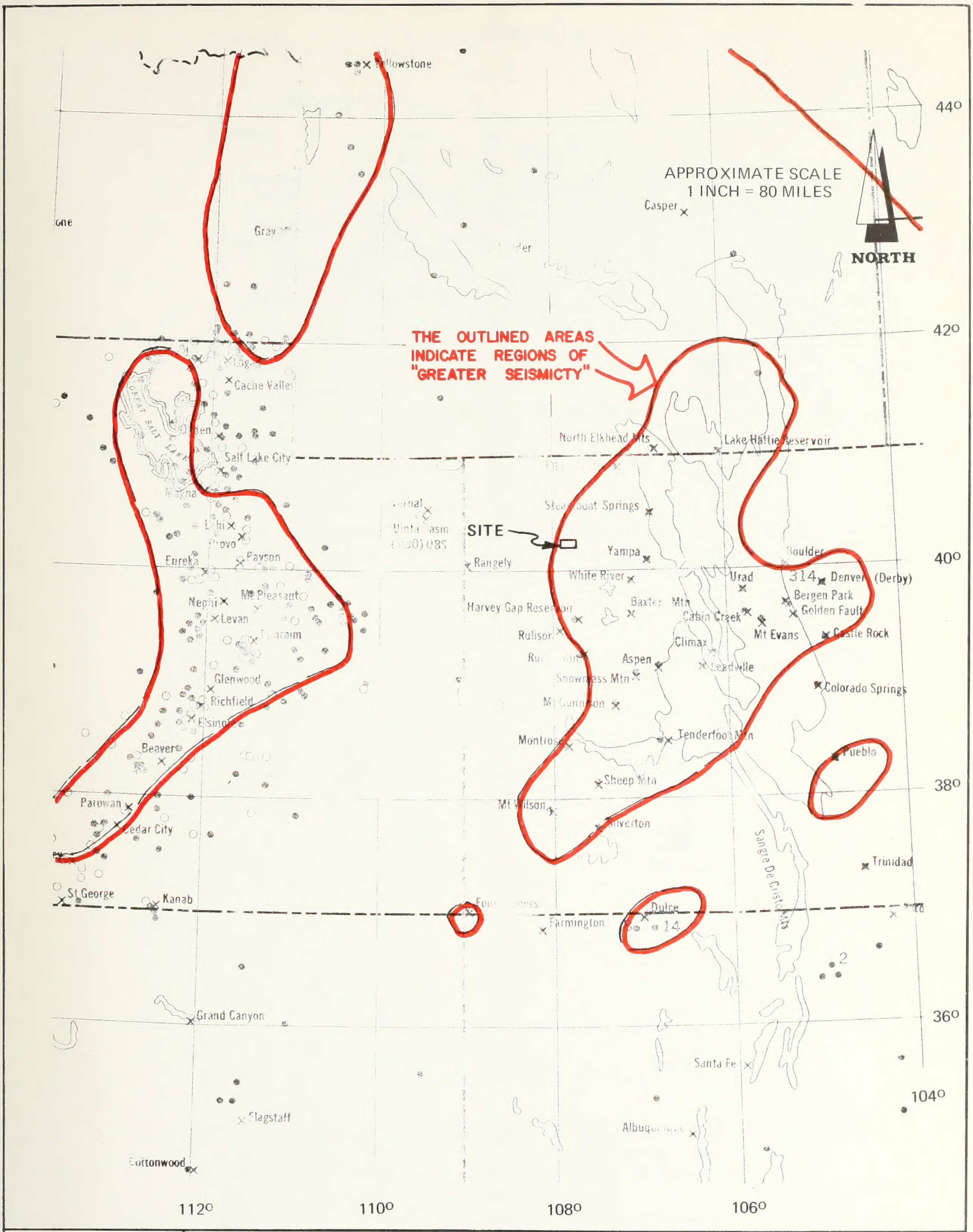
The Rocky Mountain region is considered to be a moderately active earthquake region and only recently has the regional density of seismographs been capable of detecting small seismic events (less than Richter Magnitude 5.0) and locating them accurately enough to define possible "active" faults. Two nearly north-trending "active" belts of seismicity have been defined: the easternmost "mineral belt" lies mainly within Colorado and subparallel to the Rocky Mountain's front (Figures 14 and 15). The Axial Basin and the site area lie in the western edge of this belt. The site is located within a region of "greater seismicity" (Simon, 1972) characterized by the potential for Modified Mercalli intensities of V11 or greater and Richter Magnitudes of 5.0 or greater.

Site Vicinity

All instrumentally recorded earthquakes within at least 100 miles of the site (NOAA, 1974) that were recorded between 1941 and 1974 were analyzed. Three events of Richter Magnitude 5.0 to 5.5 were recorded within 150 miles of the site, all since November, 1960; two of these were within 50 miles of the site and resulted from shallow nuclear explosions associated with tests by the Atomic Energy Commission's Rio Blanco Project (oral communication, C.A. von Hake, 1974). No seismic event has been located within the site boundaries. The nearest of these artificial earthquake epicenters had a Richter Magnitude 5.4 on May 17, 1973, approximately 40 miles southwest of the site. The remaining natural earthquake event occurred on October 11, 1960, and was centered approximately 130 to 150 miles to the south. It had a Richter Magnitude of 5.5 and probably was not felt in the site area.

Significant events that occurred prior to installation of reliable seismograph networks are reported with approximate epicentral locations and intensities in the near-epicentral region. The following is a summary of those reports for shocks believed to have been felt in the site area as taken from Coffman and von Hake (1973):

1) 1895. March 22. Colorado. Noise like blast at Steamboat Springs; low rumble. Felt from Pleasant Valley, 12 miles south, to Hayden, 25 miles northwest. (Maximum M.M. Intensity = V (est.))



REGIONAL SEISMICITY MAP

SOURCE: ROCKY MOUNTAIN ASSOCIATION OF GEOLOGISTS, SIMON, 1972

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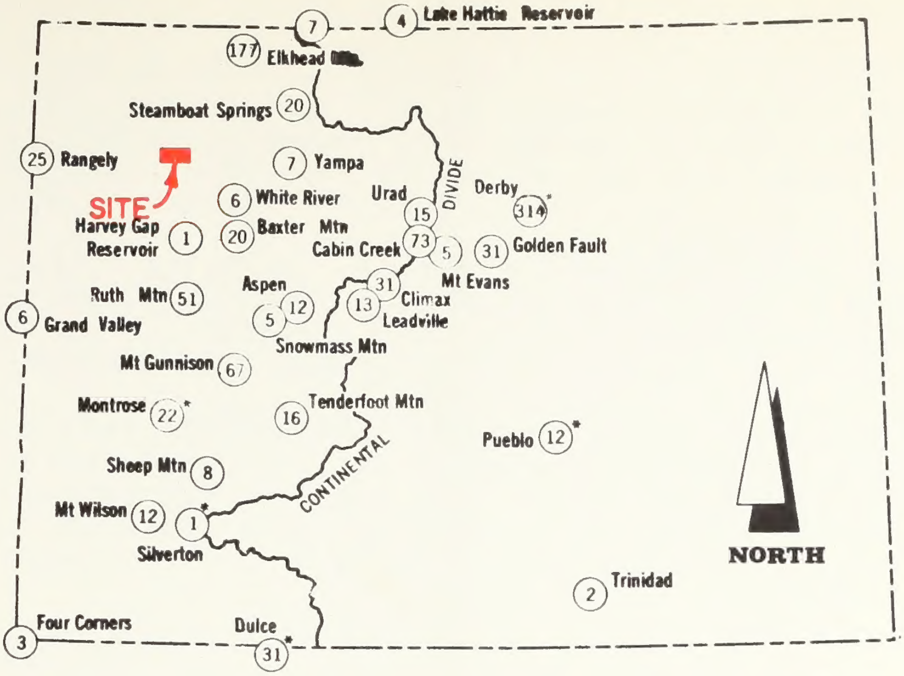
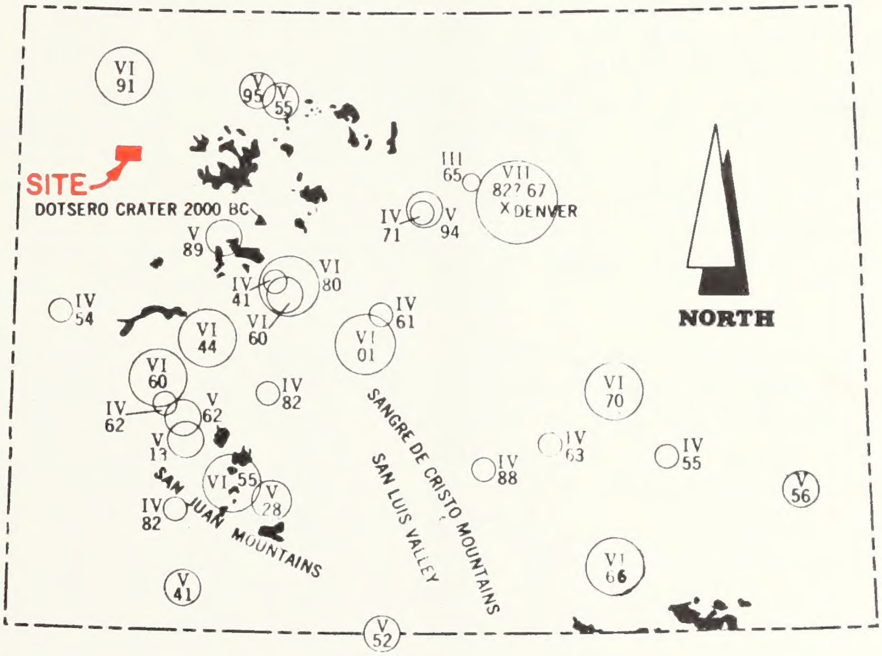
FIGURE 14



SEISMICITY IN COLORADO.
Circles show epicentral location of earthquakes in Colorado in 1967 of magnitude 2.0 or greater. Number in circle indicates number of shocks recorded. Asterisk indicates location of earthquakes of magnitude greater than 4 (Simon, 1969).



KNOWN SIGNIFICANT EARTHQUAKES OF RECORD IN COLORADO.
Roman numerals and radii of circles denote maximum observed intensity. Two-digit Arabic numbers denote year of occurrence. Adapted from F. A. Hadsell (1968).

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SEISMICITY AND EARTHQUAKES IN COLORADO

SOURCES: ROCKY MOUNTAIN ASSOCIATION OF GEOLOGISTS, SIMON, 1972

FIGURE 15

2) 1955. February 10. Northwestern Colorado. Shock caused minor damage at Steamboat Springs. Buildings rattled in Hayden, Kremmling, and Oak Creek. (Maximum M.M. Intensity = V (est.)

3) 1970. April 21. Rangley, Colorado. Small objects shifted and overturned in Texas Oil Camp. An aftershock was felt six hours later. Magnitude 3.9. (Maximum M.M. Intensity = V (est.)

It appears that historically the highest Modified Mercalli intensities at the site, due to natural earthquake events, occurred during the 1895 and 1955 events and may have reached III to V. Modified Mercalli intensities during the Rio Blanco nuclear blast may have reached IV near Axial.

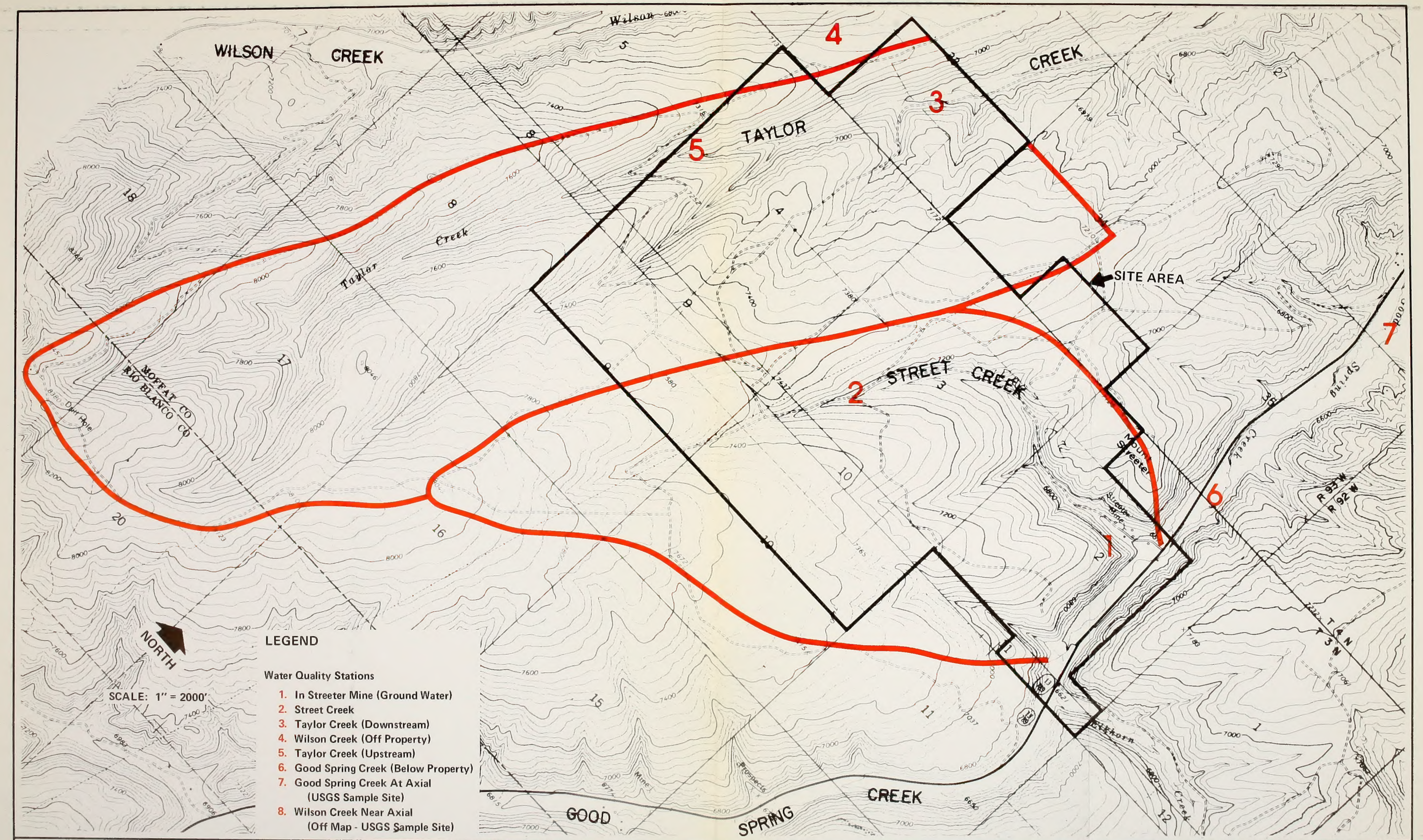
6. SURFACE WATER

The proposed Colowyo Mine boundaries fall within the drainage basins of two small stream systems; the Wilson Creek drainage and the Good Springs Creek drainage. Wilson Creek flows parallel to the western boundaries of the Colowyo Mine Company properties and collects on-site waters from the Taylor Creek drainage, as is illustrated in Figure 16. Good Springs Creek borders the property on the east and also flows in a northerly direction. On-site contributions to this drainage system come from two sources. These are Street Creek, which drains all of the property to the east of the Taylor Creek boundaries and to the west of Good Springs Creek, and Elk Horn Creek which empties into Good Springs Creek along the southeastern boundary of the Colowyo Mine property. Street Creek dischages into a series of man-made ponds which were originally constructed for stock ponds. Water from these ponds ultimately contributes to the total flow in Good Springs Creek by ground water return and by pond system overflow.

All of these streams draining the mine property eventually flow into the Yampa River drainage system. The streams are shown along with their drainage basins in Figure16. This map also contains the location of the water quality sample sites which were established for this study. This subject will be more fully developed in a subsequent section.

Drainage Patterns

Of the approximately 4.1 square miles of property currently earmarked for mining development by Colowyo Coal Company at this location, roughly 2.3 square miles (or 56 percent) supply water to Street Creek drainage. The other 1.8 square miles, (or 44 percent) of these lands, are drained by Taylor Creek waters which flow off property into Wilson Creek.



DRAINAGE BASIN MAP AND WATER QUALITY SAMPLE STATIONS
PROPOSED COLOWYO COAL MINE

Source: Prepared by VTN

FIGURE 16

WILSON CREEK DRAINAGE (SAMPLE SITE)

STOCK POND NEAR STREET CREEK

WILSON CREEK AT STATE HIGHWAY 13

TAYLOR CREEK DOWNSTREAM (SAMPLE SITE)

Both of these drainage systems arise on lands immediately upstream from the proposed development and impart good drainage potential to their respective watersheds. Illustrative of this point are the calculated drainage densities of 2.38 and 1.99 for the Street Creek and Taylor Creek systems, respectively. These calculations represent a ratio of drainage basin size (in square miles) to the total stream lengths draining each individual watershed. Access road construction on the site has resulted in alterations to traditional flow patterns at various points along the drainage courses. During spring runoff, ephemeral springs and creeks are often seen flowing along and across unpaved road surfaces, resulting in accelerated erosion and higher downstream turbidities.

There are no stream gaging stations which monitor the flow of Wilson Creek, Taylor Creek or Good Springs Creek near the proposed Colowyo mining area. Field estimates of flow during the peak runoff season of May, 1974, set values of approximately 20 cfs (cubic feet per second) and 10 cfs for Wilson Creek, Taylor Creek and Good Springs Creek, respectively, in the area of the proposed Colowyo Mine. Taylor Creek normally goes dry during the late summer and fall months. Peak runoff is normally experienced during April and May from the spring snow melt. Smaller ephemeral watercourses such as Street Creek, which originate on the mine property, are fed by snow melt and springs which drain discontinuous small aquifers that outcrop throughout the area. These shallow aquifers are directly recharged by infiltrating snow melt, stock-pond water and surface runoff.

Impoundments

There are numerous small man-made impoundments on the property which are used to augment the normal water supplies for livestock. Most of these reservoirs have a capacity of less than one-half an acre-foot. There are four of these stock ponds which exceed one acre-foot capacity. Two are located on Taylor Creek and two near the headwaters of Street Creek.

Quality

Chemical Composition: Water quality data for the area have been collected by a USGS study team evaluating the effects of existing coal developments on the receiving systems in the region. Two water quality stations were established by this team on surface water locations near the Colowyo Coal Company properties. In addition to these stations, VTN personnel have collected samples for water quality processing at six other sites. These numbered site locations are included in Figure 16 and the data

from these analyses is given by site number in Table 6.

Investigations of the type undertaken by the USGS are concerned with evaluating the potential for the occurrence of extensive acid mine drainage formation in Colorado waters. Because of the low sulfur content of Colorado coal seams to be mined and the higher alkalinity of western waters, the resulting effects have not nor would be expected to be as severe as those experienced in other geographic locales.

The data collected at the Colowyo Mine properties, as expected, are not indicative of an acidic discharge. The pH levels are high at all sites sampled and concentrations of total dissolved solids and sulfates are much lower than would be encountered in a "typical" acidic drainage. Further, the data are indicative of streams which are receiving the majority of their total volume of flow from surface oriented sources (i.e., snow melt, rainfall, etc.) rather than as discharge from subsurface water. A comparison of calculated values derived for each parameter at sampling sites 2 through 6 with similar values found at site 1. Waters collected at site 1 are exclusively ground water in origin, as they represent a composite of waters from all of the aquifers that were intercepted by the now closed Red Wing Mine Excluding turbidity, waters analyzed from site 1 have generally higher values for each of the parameters measured than do the surface waters collected at the other sample stations.

In summary, all of the waters collected and subsequently analyzed from the proposed coal mine development could be considered to be representative of the waters of the entire geographic region. Comparisons of the values in Table 6 , with published data from other sources, shows that region-wide similarities exist (Colorado Water Resources-Circular No. 15; Williams Fork Study). Each of the parameters included in Table 6 falls within the range observed in water systems found in the geographic region.

Erosion and Sedimentation: The Colorado Land Use Commission classified the general region encompassing the Colowyo Mine property boundaries as contributing a low yield of dissolved and suspended sediments to the overall stream system. They gauge erosion rates on these lands to be in the 0.1 to 0.2 acre feet per square mile per year range and attribute this to a combination of factors. Included in their criteria are:

1) surface geology
2) soils
3) climate and runoff
4) topography
5) ground cover
6) land use

TABLE 6

WATER QUALITY DETERMINATIONS

Colowyo Coal Mine Project

				MG/LITER						
Site Number	pH	Conductivity mcm/cc	Turbidity (JTV)	Calcium	Magnesium	Hardness (CaCO3 eq)	Sodium	Total Dissolved Solids	Total Suspended Solids	Sulfate
1	7.7	1960	53	140	150	975	79	1641	288	510
2	8.1	1070	460	110	38	430	22	740	885	58
3	8.3	1140	200	88	46	410	20	680	421	86
4	8.2	1200	230	62	32	290	64	670	607	42
5	8.3	925	300	78	35	340	16	570	688	28
6	8.4	1200	320	82	66	480	31	800	72	180
7	8.5	1600	–	–	–	–	–	1040*	–	–
8	8.4	2000	–	–	–	–	–	1300*	–	–

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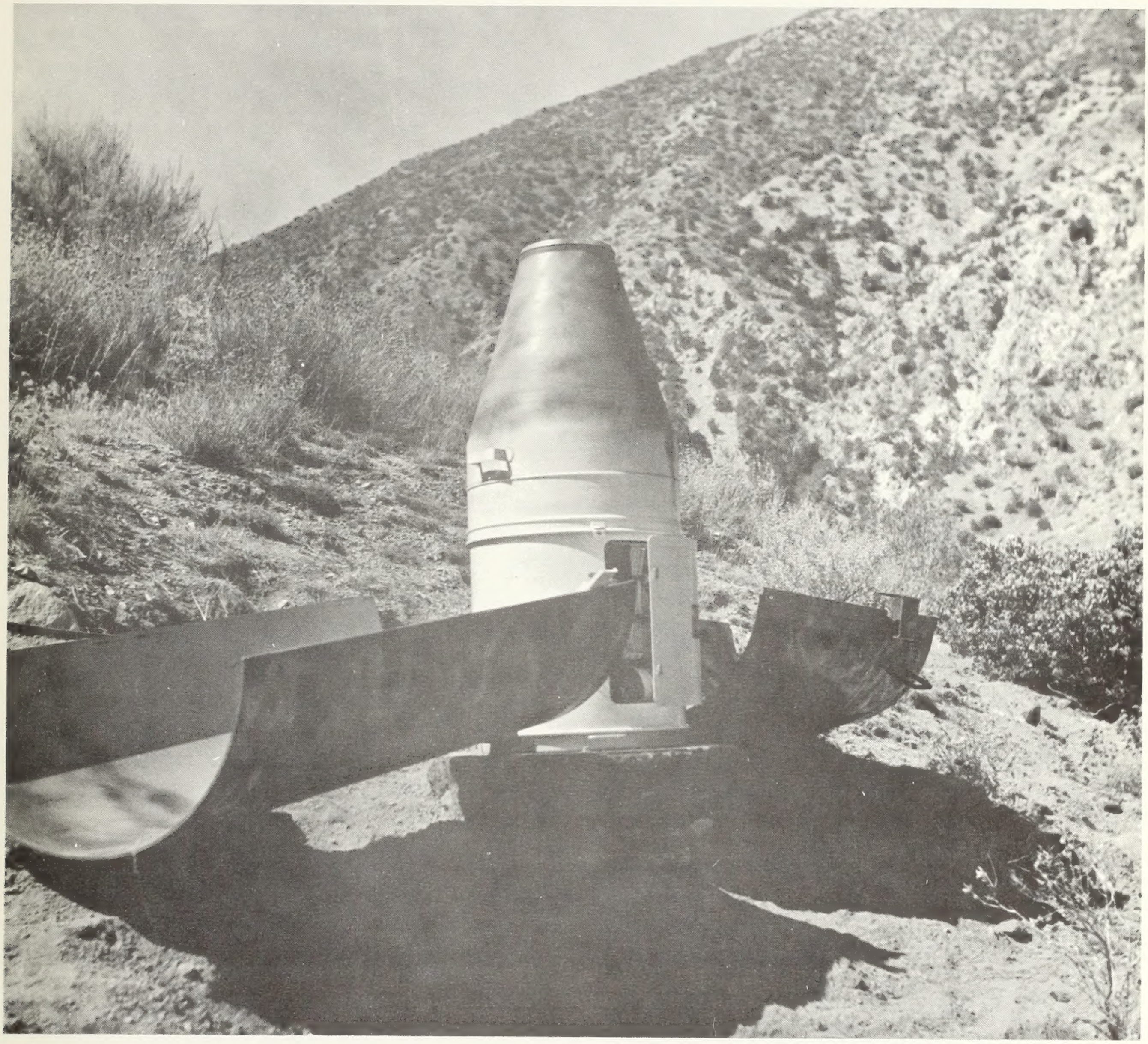
*± .005

1 - Mine (Colowyo)
2 - Street Creek
3 - Taylor Creek
4 - Wilson Creek
5 - Taylor Creek (head)
6 - Good Springs Creek (below mine)
7 - Good Springs Creek at Axial, Colorado
8 - Wilson Creek near Axial, Colorado

Source: Prepared by VTN



TYPICAL RAINFALL MONITORING STATION TO BE USED IN THE MONITORING PROGRAM

Of all the streams in the general area, Wilson Creek exhibits the greatest amounts of erosion. Less riparian vegetation is found on the slopes adjacent to this stream system than is noted along the other drainages. Heavy erosion for this stream is confined to particular sections of the stream channel. A dramatic cyclical pattern of deposition, erosion, and further deposition is observed along the course of this stream adjacent to the mine property.

Water Use

At present, the only definitive use made of the waters flowing from the property is in the downstream irrigation systems and stock-watering operations. There are several senior appropriators on the Wilson and Good Springs watersheds who maintain a strong interest in the waters flowing from these respective drainages. At present, there are no industrial users of water on the Colowyo Mine property itself. All on-site water uses are confined to the numerous stock ponds.

7. CLIMATE

The western slope region of northwestern Colorado experiences a semi-arid steppe climate with continental influence typical of a high plains mid-latitude region cut off from marine air masses. Low relative humidity with low precipitation and abundant sunshine are typical of this climate. Seasonal and daily variations in temperature can be extreme, however, most snowstorms and cold weather extremes occur during the night and generally pass by the area quickly, leaving cool sunny days. Hot summer days usually are quite pleasant due to the low relative humidity, and summer nights are generally quite cool.

Precipitation generally occurs throughout the year in the form of heavy powdery snow in the winter, and as fast moving thunderstorms during the summer. The Sierra Nevada Mountain range acts as a natural barrier blocking moist maritime air from the north Pacific from reaching the interior basins to the east.

The Continental Divide forms the eastern boundary of the western slope in the highlands of the Rocky Mountains. Because the Divide is lower in elevation north of the region, in Wyoming, and south of the region, in New Mexico, severe storms and low pressure systems which are blown into the area by the prevailing winds from the west veer north or south over the lower mountain barriers and bypass the region. High pressure systems become trapped in the area and generally linger on for several days or weeks. Severe cold waves and storms move through the area quite rapidly.

Elevation plays an important role in regulating temperature, precipitation and wind flow. Stationary high pressure systems which establish themselves in the area during the winter months are conducive to heavy dry snowfall. Precipitation in the area ranges from about nine inches in the lower elevations to as much as 50 inches on the Continental Divide. As much as 10,000 feet variation in elevation is quite common in a relatively small geographic area. Elevation, topography, mountain barriers, soil type and moisture, vegetation and air drainage all play an important micro-climatic role in regulating the climate of the area since most of the region is at an elevation greater than 4,000 feet above sea level, and 1,000 miles from the moderating influence of the Pacific Ocean.

Temperature

There is no existing weather station on the proposed Colowyo Mine site. The site will be subject to varying degrees of micro-climatic effects. Speculations as to temperature ranges and growing seasons are based on existing data from stations surrounding the site. These stations are delineated in Table 7 with the average regional means and extremes of temperature variations. As the Table indicates, July is the hottest month of the year and may often be in the low 90's in the daytime and mid 40's to low 50's at night. The average mean temperature will be in the mid 60's and the average daily temperature mean will be in the mid 80's. Nightly lows will be in the high 40's. Temperature may go as high as 100° or greater during the summer months. However, the humidity will remain low and the nights will be quite cool and clear.

January is the coldest month of the year. During the winter the average daily temperature mean will be in the mid to low 20's with the mean daily temperatures ranging from the high 30's to about 9° at night. Nighttime extremes may often be below -20° and may reach below 40°. North and south facing slopes and slopes in shadows may vary greatly in temperature due to rapid heat disbursement into the atmosphere caused by the high altitude. Except during storms, clear sunny skies with low relative humidity will make the cool days comfortable.

Most snowstorms and cold weather extremes will occur during the night. The average frost-free growing season will be about 80 to 90 days, from mid-June to about early mid-September.

Precipitation

Precipitation occurs evenly throughout the year in the project area and is also subject to micro-climatic effects. Table 8

TABLE 7

AVERAGE REGIONAL TEMPERATURES

Station	Mean Annual Temperatures	Maximum Recorded Temperatures	Minimum Recorded Temperatures	Maximum Monthly Mean			Minimum Monthly Mean		
				High	Low	Mean	High	Low	Mean
Craig	42.0°	100°	-45°	July 85.9°	47.3°	66.6°	January 32.3°	1.5°	16.9°
Hayden	41.4°	102°	-44°	July 86.2°	45.9°	66°	January 32.1°	2.9°	17.5°
Meeker	44.4°	June 100°	February -33°	July 86.4°	44.6°	67.0°	January 38.1°	9.5°	23.8°
Rangely	42.8°	June 104°	January -37°	July 93.0°	54.2°	73.6°	January 33.2°	3.6°	18.4°
Rifle	47.8°	July 104°	February -34°	July 91.2°	50.7°	71.0°	January 37.0°	9.4°	23.2°
Steamboat Springs	39.0°	99°	-54°	July 81.4°	39.7°	60.5°	January 28.4°	-.8°	13.8°

*Data Unavailable

Source: U.S. Weather Bureau

TABLE 8

AVERAGE REGIONAL PRECIPITATION

Station	Average Annual Snowfall	Average Annual Precipitation	Maximum Monthly Precipitation	Minimum Monthly Precipitation
Craig	62.0″	13.4″	August 2.36″	February .81″
Columbine	181.2″	22.9″	March 2.35″	June 1.22″
Hayden	97.6″	15.5″	April 1.50″	November 1.09″
Meeker	91.5″	17.68″	August 2.15″	June 1.08″
Pagoda	106.2″	18.5″	March 1.95″	November .97″
Rangely	40.8″	8.87″	August 1.37″	June .52″
Rifle	37.8″	10.93″	August 1.20″	June .69″
Steamboat Springs	166.9″	23.5″	December 2.45″	September 1.48″
Yampa	76.6″	16.0″	January 1.96″	May .80″

*Data Unavailable

Source: U.S. Weather Bureau

shows the regional average amounts of snowfall and precipitation. Although there is no weather station near the site proper, it is estimated that an average of 16 to 18 inches of precipitation a year can be expected. At least one-third of the precipitation occurs as snow and at least one-third as fast moving summer thunderstorms during the growing season. Measurable snowfall will occur between October and May with slight snowfall in late September. The greatest snowfall will occur in January.

The project site can expect an average of 90 to 100 inches of snowfall a year. Approximately 70 percent of the snowfall will occur during the night in the form of light dry powder averaging ten inches of snow to one inch of water. It can be assumed that approximately one-half of the annual precipitation at the site will occur as snow (Colorado State University, 1971.) Large windblown snowdrifts 60 feet or greater may accumulate in canyons sheltered from the hot afternoon sun. Snowpeaks will average between two to six feet deep. Slopes exposed to afternoon sun will soon melt except in higher elevations. Snowpeaks will start forming in December. Most of the snowpeaks will melt starting in late April, but on higher elevations toward the Continental Divide, they might not melt until late June or July. Some of the higher peaks in the Rockies have snow all year.

The snowmelt runoff and groundwater recharge, combined with summer thunderstorm runoff provides water for irrigation in the project area during the growing season. During the summer months an average of one to two inches of rainfall will occur monthly. Cloudburst thunderstorms of short duration result in low total water production, and high peak sheet flow runoff. This rapid runoff does not contribute much to groundwater recharge. Slow melting snows provide maximum opportunity for percolation to ground water aquifers. Summer rains, abundant sunshine and high altitude are highly conducive to rapid plant growth during the summer. Severe hail is rare in the project area. Due to the low relative humidity, occurences of fog and dew are rare and generally occur along river valleys during the winter months.

Wind

The prevailing winds over the project site will be from the west-southwest and southwest from 3 to 15 miles per hour. The wind will blow out of the north northeast 10 to 15 percent of the time. Fair weather winds will rarely exceed 24 miles per hour. The strongest winds can be expected during the winter and early spring especially in March, and briefly during the summer thunderstorms. Winds up to 100 miles per hour have been recorded in the area resultant from sharp cold fronts and thunderstorms. The direction and speed of the wind will be

greatly affected by the local topography. Wind will tend to flow up-canyon during the day and down-canyon in the night. Daily up-canyon winds can be expected to reach their peak in mid to late afternoon.

Steepness and direction of canyons and their relation to prevailing winds will be a major factor in determining up-canyon wind speed. The top ridge of steep canyons may experience strong winds greatly in excess to the speed of the prevailing winds. Wind direction may eddy in several directions around peaks, saddles and ridge tops. Unequal heating of the land surface because of terrain, and rapid heat disbursement into the atmosphere due to the high altitude, will result in the formation of many local wind patterns.

8. AIR QUALITY

The existing air quality in the vicinity of the site is excellent. There are no polluting sources near the proposed site which would deter air quality. A complete discussion of impacts on air quality resulting from mining operations is included in the impacts section.

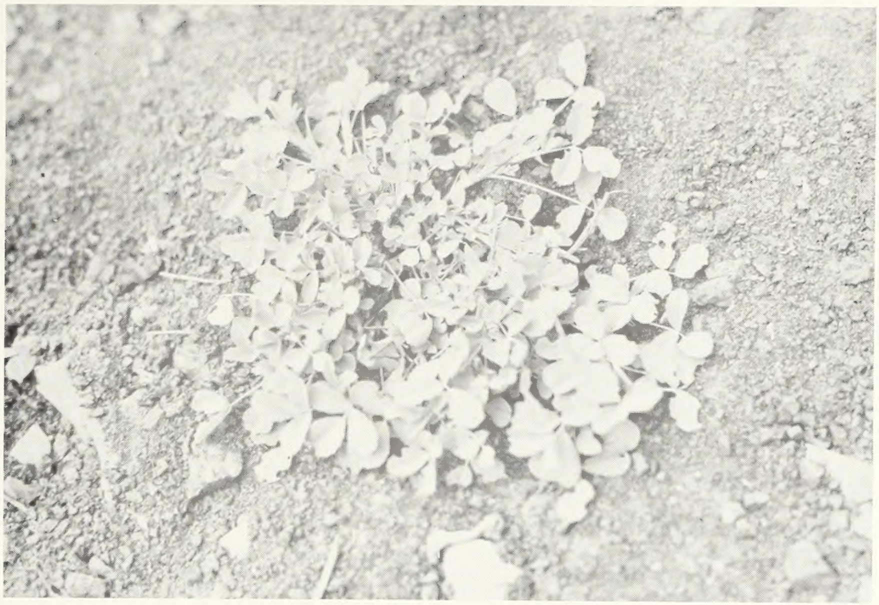
B. BIOLOGICAL ENVIRONMENT

1. NATIVE PLANT COMMUNITIES

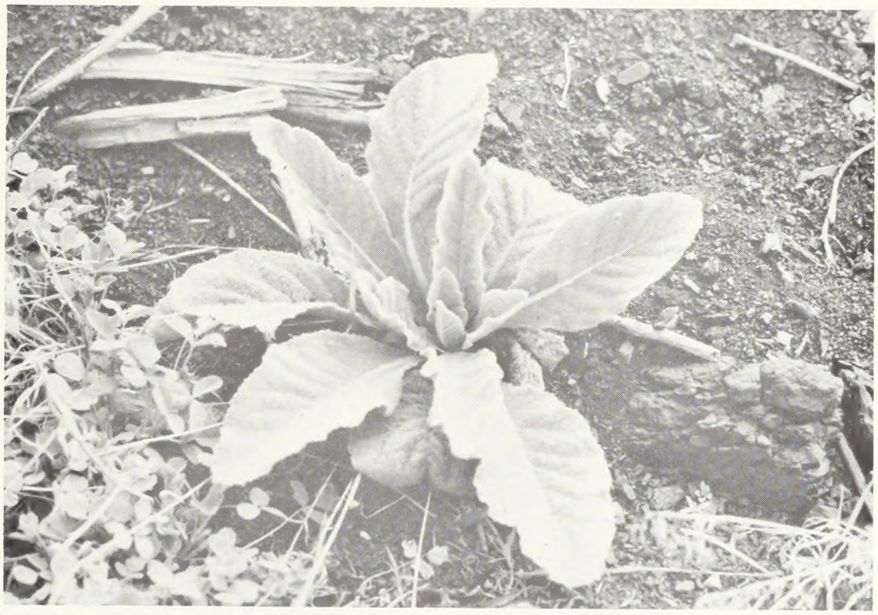
The proposed Colowyo Mine in Moffat County covers an area of approximately 2,500 acres of Colorado Western Slope brush and woodland. The VTN biological staff investigated the site during the last week in April and the second week of May 1974. The biological information contained in this report is the result of those onsite investigations and research of the pertinent existing published materials on northwestern Colorado.

Three primary and two secondary vegetative communities exist within the property boundaries. Primary groups are sagebrush, oak-serviceberry, and pinyon-juniper woodland, with the secondary groups consisting of riparian associations and aspen woodlands. For a species list, refer to Appendix B. Sagebrush communities are characterized floristically by the almost complete dominance of Artemesia tridentata (big sagebrush). The physiognomy (growth form) of this community is characterized by scattered shrubs of medium height rarely exceeding four feet. Numerous areas of bare ground exist with various grasses and forbs comprising the sparse understory. In every location where soil moisture retention becomes limiting to the other landscape components, this sagebrush steppe community develops. At the site, Symphoricarpos oreophilus (snowberry) and Amelanchier utahensis (serviceberry) locally occur within the sage where exposure or moisture retention is favorable. The oak-serviceberry community is dominated by varying densities of Quercus gambelii (Gambel's oak) and serviceberry. This plant community is widespread in Colorado between elevations of five and seven thousand feet (James and Marr, 1966). The shrubs of this community range in height from 3 to 12 feet tall. Typically, the oaks grow in large clumps with zones of sagebrush or grasses existing between the denser oak and serviceberry stands. Within this association, snowberry is more commonly found than in sage communities. Numerous forbs and grasses occur in varying densities throughout this and all the other plant communities. None of these understory plants appeared to be strictly limited to any one of the primary plant communities.

Pinyon-juniper woodlands are dominated by Pinus edulis (pinyon) and Juniperus osteosperma (juniper). This community is limited at the Colowyo site to the area around Mount Streeter and to the bluffs along Good Springs Creek. In these locations, the pinyon is very widely scattered or absent entirely from the community, leaving the woodlands dominated by juniper. Due to its physiognomy, this vegetation unit is often referred to as pygmy forest (Woodbury, 1947). The trees rarely exceed 15 feet in height and the canopy of the forest rarely is closed. Sagebrush is



Medicago hispida (ALFALFA)



Verbascum thapsus (GIANT MULLEIN)

also a conspicuous member of this plant association at the site, with various forbs and grasses occupying much of the spaces between the trees.

The riparian or stream-side communities are very limited on the subject property. Represented by *Salix* spp. (willows), *Juncus* spp. (rushes), *Carex* spp. (sedges), *Typha latifolia* (cattails), and *Populus deltoides* (cottonwood), this community occurs north of the closed Red Wing mine, along Good Springs Creek and along the creek flowing out of the property.

The groves of aspen (*Populus tremuloides*) are also of very limited extent on the Colowyo Mine property. They occur in the upper reaches of various ephemeral creeks and in locations where meltwaters continue to flow late in the spring. Forbs and grasses are more prevalent in these aspen stands than in any of the other plant communities. Snowberry also commonly occurs as an understory shrub in these stands while serviceberry commonly occurs around the periphery of the groves. The approximate extent of all the five vegetation types are shown on Figure17.

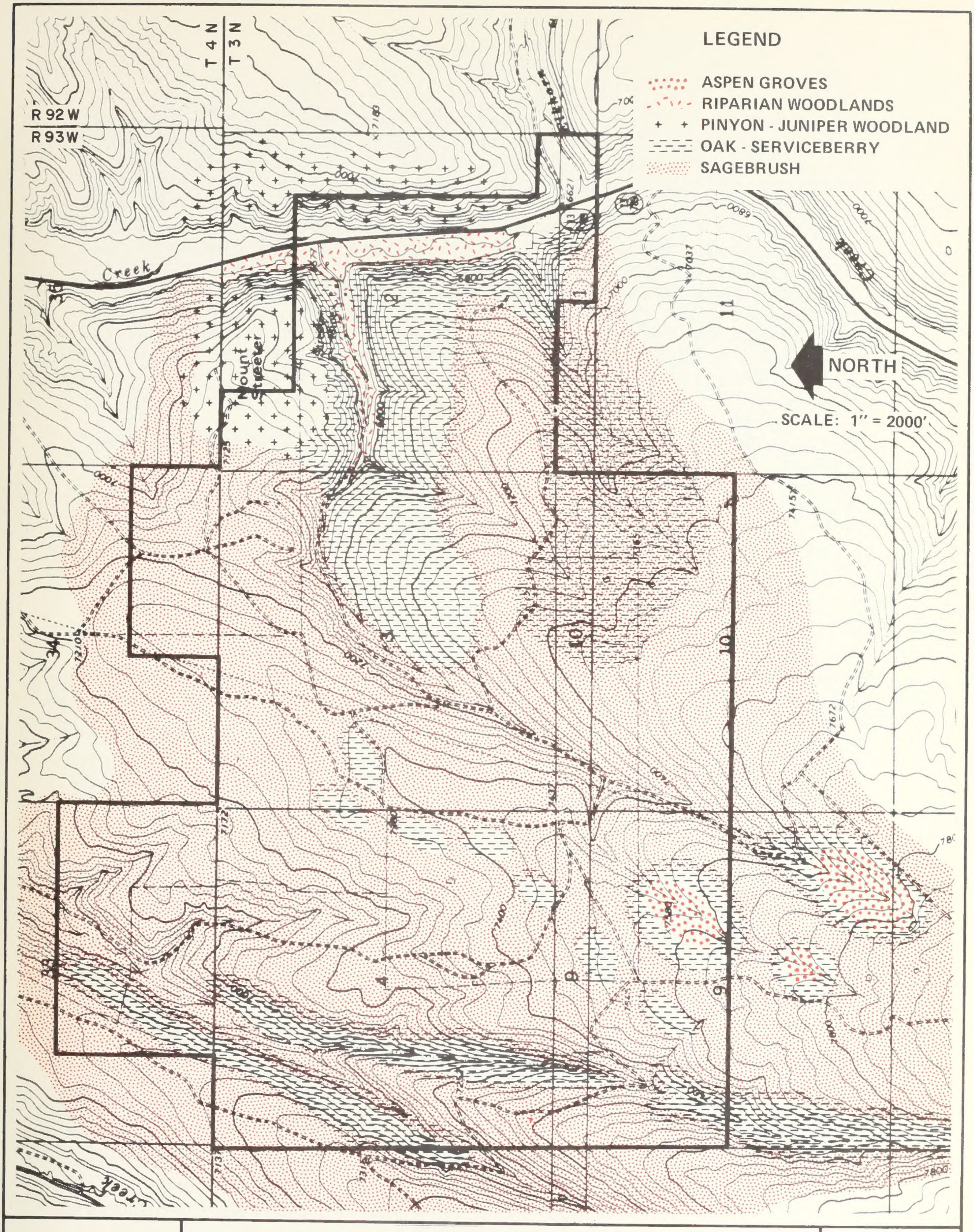
2. WILDLIFE

Game Species

The Colowyo Coal Company property provides winter range for elk and year-round range for mule deer. When surveyed in May, fresh elk tracks were found on the subject property, along with numerous droppings, but no elk were observed. The animals tracked may be moving south into the Danforth Hills, which is their summer range. The boundary between the elk's summer and winter ranges lies in the vicinity of the subject property (Colorado Game and Fish Division, 1974); however, it is not known how many elk, if any, reside on the property during the winter. Any herds may be solely transient in this portion of their range.

The region west of the subject property to Elk Springs is one of the most popular deer hunting areas in Colorado. Approximately twelve mule deer were observed on the property. Well-worn trails and large accumulations of droppings around the small stock ponds on the property indicate that the majority of these deer are resident on the proposed mine site. They appear to move back and forth between their shelter in the pinyon-juniper on Mount Streeter and the aspen groves and stock ponds in the southern portion of the property, where there is preferred forage.

The region 10 to 20 miles north of the subject property which



vtn

APPROXIMATE VEGETATION AREAS
ON THE COLOWYO
COAL MINE PROPERTY

SOURCE: PREPARED BY VTN

FIGURE 17

includes the Williams Fork and Yampa Rivers is also one of the most productive areas in Colorado for small game. The harvest of sage grouse and sharp-tailed grouse in the area of the Williams Fork-Yampa River confluence (Small Game Management Unit 6) was the highest in the State in 1973. Cottontail rabbit is likewise an important small game animal in the region (Colorado Game and Fish Division, 1973). Sage grouse were not observed on the property, but their presence can be inferred by the occurrence of sagebrush which is their preferred habitat (Rogers, 1964). Sharp-tailed grouse probably do not occur on the property itself because of the high density of brush; however, four sharp-tailed grouse dancing grounds have been reported in the area southeast of the property on the east side of Highway 13 (Rogers, 1969).

Since no permanent water supplies exist within the property limits, perennial fish populations could not persist. Several stock ponds do exist and probably attract small numbers of migrating waterfowl. No good waterfowl habitat exists anywhere on the Colowyo Mine Property.

Non-Game Species

The dominant mammals at the proposed Colowyo Mine site are rodents. These range from the relatively large yellow-bellied marmot which lives in rocky areas, to the small deer mouse, which is found throughout the area and is probably the most abundant mammal on the site. Along with the rodents, the blacktail jackrabbit and desert cottontail are important primary consumers, either eating seeds or green vegetation. The principal mammalian predators in the area are the coyote, bobcat and long-tailed weasel.

The sage and oak communities support a great variety of seed-eating birds such as the rufous-sided and green-tailed towhees, chipping sparrow and Oregon junco. Most of these birds are summer residents only and are listed in Appendix B. Predatory birds are numerous in the area, the most common ones being the marsh hawk and red-tailed hawk. Two common scavenging birds, the black-billed magpie and the turkey vulture were observed on the property.

Due to their nocturnal habits, few reptiles or amphibians were observed on the subject property. However, the area contains the habitat of the species listed in Appendix B. The most abundant lizards are probably the eastern fence lizard, sagebrush lizard and side-blotched lizard. The gopher snake and western rattlesnake are probably the most common snakes in the area. Four tiger salamanders were found in the damp earth beneath the abandoned homestead on the property.

The absence of perennial streams on the property precludes the existence of a significant fish population. However, small fish such as chubs or minnows could move up some of the intermittent streams in the spring.

Rare and Endangered Species

The only animal known to occur in the vicinity of the site that is listed as officially endangered is the American peregrine falcon (Falco peregrainus anatum), (Bureau of Sport Fisheries Wildlife, 1973). According to Bob Tully of the Colorado Division of Game and Fish, a pair of peregrine falcons breed within twenty miles of the site in an area with steep cliffs. It is highly unlikely that these birds will be disturbed by activity on the site, unless they fly over it while hunting.

The black-footed ferret (Mustela nigripes) is a potential inhabitant of the area. They are generally believed to be associated with prairie dogs. A site inspection revealed that there are no prairie dog towns on the property, therefore the presence of the ferret is very remote. The last official record of the black-footed ferret in the area was a collection specimen taken west of Craig in 1942 (Armstron, 1972).

The wolverine (Gulo gulo luscus) is considered to be endangered in Colorado. It has been observed in the mountainous regions between Craig and Meeker (Armstron, 1972) but it would not be found near the property as it is strictly a high-mountain forest species.

3. ECOSYSTEM CHARACTERISTICS

Trophic Relationships

Ecosystems are complex associations of environmental parameters and biological populations. Each component contributes to the structure, function, and dynamics of the whole system. As such, simply a mention of the plant, animal, or edaphic members would not produce an adequate picture of their actual relationships. Energy, being the basic component to the structure of any ecosystem, orginates with the available sunlight. The first trophic level to utilize this energy is thus the vegetation covering the landscape. The plants or primary producers utilize this energy in the production of organic materials. Following the producers, the next trophic level includes the primary consumers which are usually animals and insects that feed directly off the vegetable matter of the ecosystem. The energy absorbed

by the plants is now integrated into the tissues of the consumers. Above the level of the primary consumer occur the primary, secondary, and often tertiary consumer. These are represented by the carnivors which receive their energy from preying upon the herbivores.

On the Colowyo Coal Company property, these trophic relationships are well represented. At the first trophic level exist the various plant communities, i.e., sagebrush steppe, oak-serviceberry, pinyon-juniper woodlands, riparian woodland and aspen groves, which cover the landscape. At the primary consumer or herbivore level exist the elk, deer, sage grouse, seed-eating birds, gophers, and mice. Coyote, bobcat, mountain lion, weasel, and the raptors (hawks, falcons, eagles, etc.) would occupy the highest or preditory trophic levels. Because the present landscape on the property contains a variety of vegetation types, the trophic relationship cannot be described as a simple food chain, but rather should be thought of as a food web. Even though the deer or elk may browse or associate with only one of the vegetation types, migration patterns or watering peculiarities bring them in contact with all of the other landscape components. The aspen groves on the property show much higher animal usage than would normally be expected by their size. This is certainly related to the adequate water supply in the stock ponds found near the trees.

Completing the food web are the reducers or decomposers. These include the organisms, usually bacteria and fungi, which work on the dead animal and vegetable matter and return the various organic and inorganic nutrients into the soil system. The cycle repeats itself from this point.

In "climax" or stable ecosystems, these processes of energy uptake and dissipation are in a steady state of balance. Left undisturbed by climatic manmade influences, these systems and processes will continue indefinitely. Successional or disturbed communities do not show the above patterns and are normally characterized by pronounced fluctuations in plant biomass production and animal population levels. Until the climatically controlled plant communities are re-established, these fluctuations continue.

Succession

The vegetation in and around the vicinity of the Colowyo Coal Company property is a complex mosaic where moisture, exposure, grazing, and general land use history are the controlling factors in the plant distribution. On the western slope of the Rocky Mountains, moisture is most always the general limiting factor for the distribution of vegetation and wildlife (James

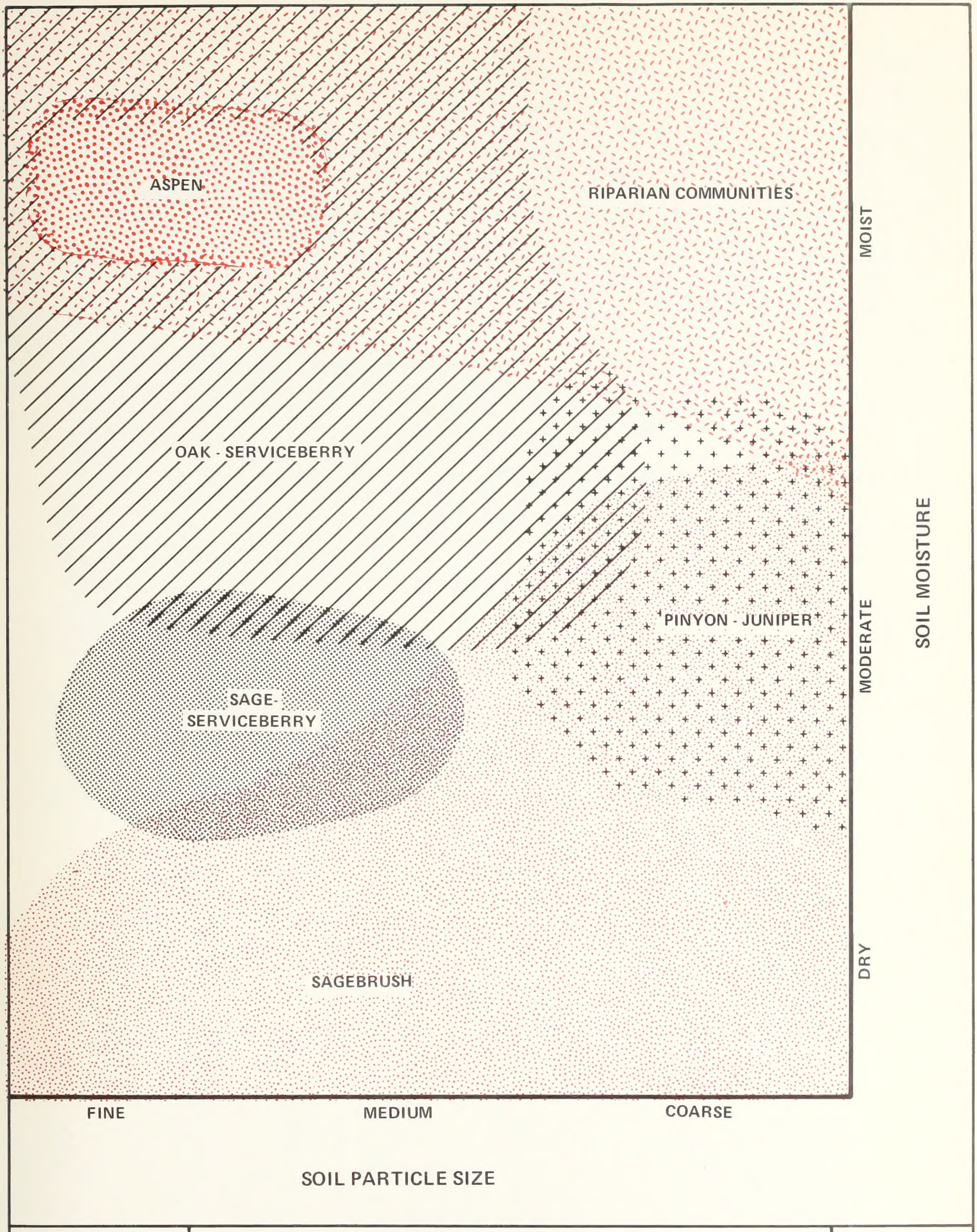
and Marr, 1966). On the property, stands of oak and serviceberry develop on the slopes where snow collects and lies late or where moisture is in adequate supply throughout the spring. On dryer sites where moisture is somewhat more limiting, the oaks lose their dominance in this community and the stands become dominated by serviceberry. The ecological tolerance distributions of the major vegetation units on the property are represented by Figure 18. Following the progression toward the dryer end of the scale, it is evident that the sagebrush communities dominate all those locations where moisture is limiting to the other landscape components. These include many south-and west-facing slopes and all of the ridge tops. Occasionally, individuals of serviceberry will occur among the sagebrush where localized topographic influences produce a favorable microsite for growth and development. Brown (1958) points out that the absence of coniferous species on north-facing slopes is strong evidence supporting the idea of the ecological stability of the shrub/oak communities. Brown (1958) also suggests that the extent and density of the shrub/oak vegetation type in West Central Colorado is probably not much different today than it was in the late 1800's.

The aspen and riparian communities occur where moisture is persistent during the spring or occurs throughout the growing season. Since these conditions are limited on the Colowyo Coal Company property, the aspen and riparian associations are also of limited extent.

Pinyon-juniper woodland on the subject property is restricted to the ridgetops of Mount Streeter and the bedrock walls along Good Springs Creek. In these locations, soil is very shallow or nonexistent. Physiologically, these coniferous species are unable to tolerate the accumulation of fine soil particles around the roots, so they occur only where the bedrock is close to the surface or outcrops. Woodbury (1947) demonstrated that sagebrush is adapted to fine, deep soils and juniper to coarse porous soils and that these vegetation types are segregated on that basis. In the present locations, the pinyon-juniper woodland consists almost exclusively of juniper. The absence of pinyon may be due to the fact that the site is near the northern distribution limit of this species, or it may be due to historical disturbances, such as fire or disease. Juniper is often found to recover from disturbance more readily than pinyon (Woodbury, 1947).

In all of the plant associations on the property, bulbs or rhizomataceous plants are very common. This indicates that the soils dry out quite rapidly after the spring season, producing considerable moisture stress during the summer months. The genus Allium (onion) was especially prevalent.

Grazing appears to have had or continues to have a profound



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ENVIRONMENTAL GRADIENT/
PLANT TOLERANCE GRAPH

Source: Prepared by VTN

FIGURE 18

influence on the ecosystems at the Colowyo Mine site. All five vegetation units show signs of overgrazing. These include soil trampling, decline of grasses, and vast quantities of scat. In the aspen stands, it was apparent that stand regeneration was not occurring, possibly due to the effects of this overgrazing. The aspen groves appear to be relic stands from a once more widely distributed forest. These stands will probably disappear from the property as the individual aspen boles die and are not replaced by new trees. In these locations, the aspen are being replaced by serviceberry.

The primary plant communities present are stable or "climax" for the topography and elevation of this region of Colorado (James and Marr, 1966). If a major disturbance, such as a fire, should destroy either the sagebrush or the oak-serviceberry communities, it is doubtful whether the seral stands would differ in species composition from the climax ones. Rather, it is more likely that the changes would be more in terms of species densities. Weedy annuals would also occur in larger numbers than are now present. The return to "climax" conditions would depend on the extent to which the landscape was protected from further disturbance and the natural controlling factor of marginal ecosystem moisture. It could be expected that sagebrush communities would tend to expand in area if destruction of the other communities should occur.

C. THE SOCIAL ENVIRONMENT

1. BOUNDARIES

The Counties of Moffat, Rio Blanco, and Routt, which comprise the tri-county study region, will be used for the purpose of assessing sociological and economic impacts directly related to the proposed Colowyo Mine, since these three counties have similar characteristics and interrelate extensively. More specifically, the communities of Craig (in Moffat County) and Meeker (in Rio Blanco County) and adjacent peripheral settlements will be the most directly affected by mining development since these are the nearest and most logical areas of location for mining and mining related employees. For the purposes of this report, the area between Craig and Meeker will be designated as a growth corridor. However, it is most probable that Craig will see the most growth and related effects of this growth caused by Colowyo Mine development. It is also possible that some mining and mining related employees will locate in the communities of Hayden and Steamboat Springs (in Routt County); social characteristics are compiled for this area as well.

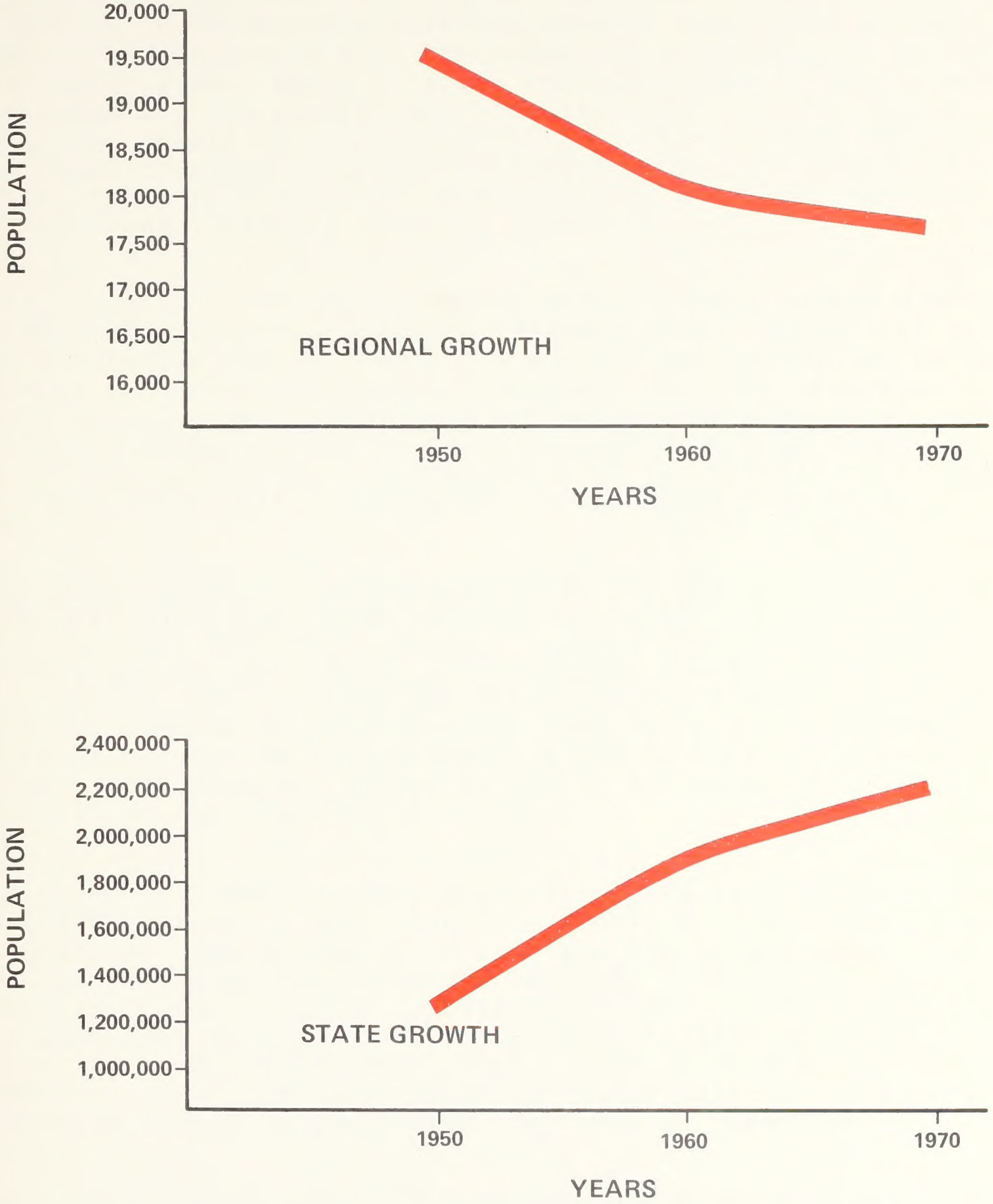
2. SOCIAL CHARACTERISITICS OF THE POPULATION

Population Characteristics

Existing Population: 1970 population characteristics for the counties and cities in the tri-county area are given in Table 9. The tri-county region, in 1970, had a population of 17,959, which is 0.8 percent of the State's total population. Growth has been erratic during the last fifty years. Steady population increases were recorded until 1950; the population then declined sharply in 1960 and 1970, resulting in an 8.4 percent loss in total population. These changes were due to a decline in the mining industry and better wages and employment in urbanized areas.

In contrast with this region, the State of Colorado has experienced rapid growth during the past 20 years. During the period of 1960 to 1970, Colorado grew by 25.8 percent, compared to the United States' increase of only 13.3 percent (Bureau of the Census, 1972), Figure 19.

Rural and urban population in the tri-county region distribution also varies from the State trend. Colorado population distribution is classified as 48.5 percent urban, while the tri-county region is predominantly rural, having a 23.7 percent urban



GROWTH PATTERN RELATIONSHIPS
FOR THE TRI-COUNTY REGION
AND THE STATE OF COLORADO

SOURCE: PREPARED BY VTN

FIGURE 19

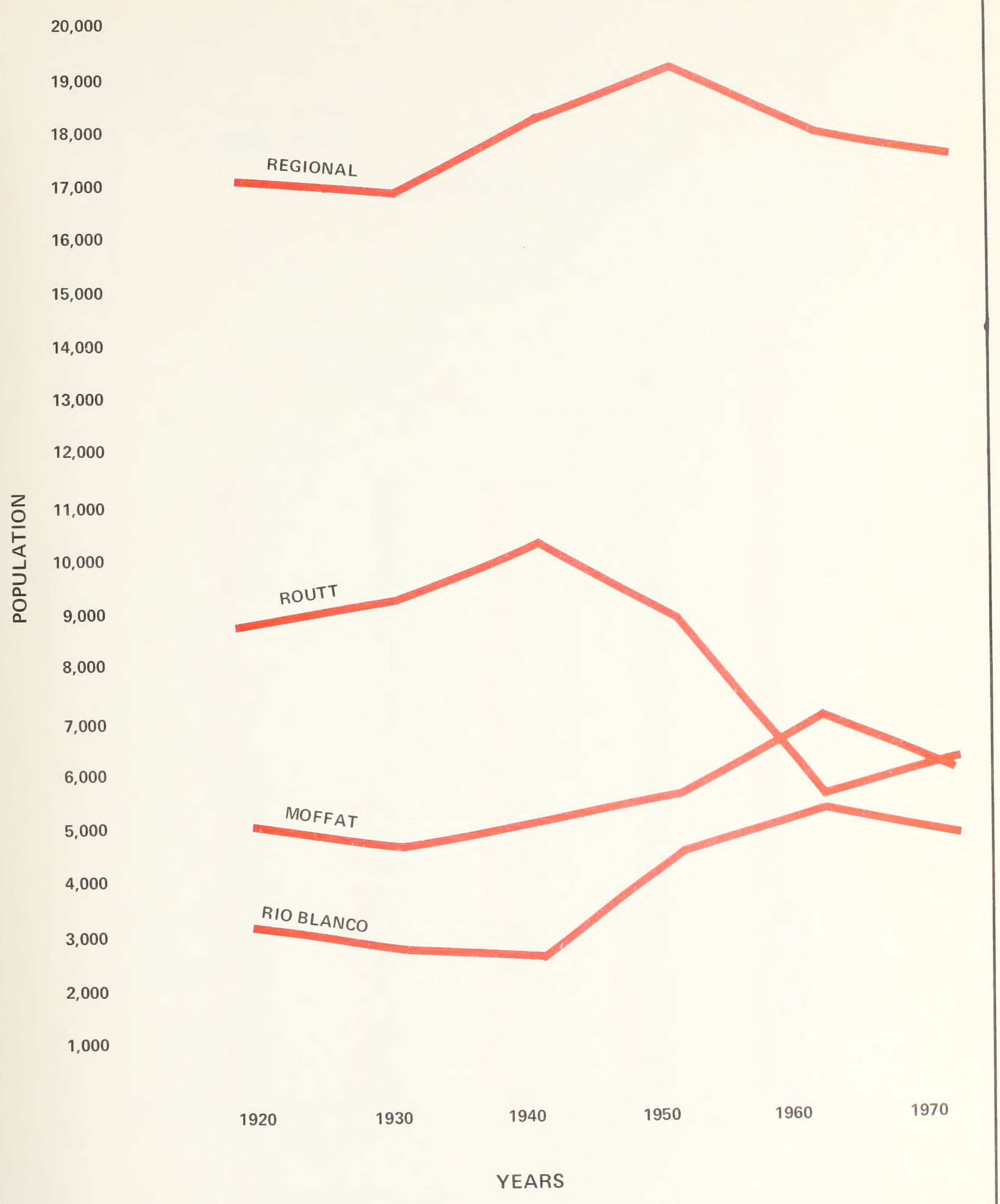
population. The U. S. Bureau of Census defines the communities of Steamboat Springs, Meeker, Hayden, and Rangely as rural population areas. The City of Craig is considered urban since it comprises an incorporated population greater than 2,500 persons. Table 9 and Figure 21 give the urban and rural population for the tri-county area. Table 10 gives the population by county subdivisions and the subdivision boundaries for the tri-county area. It should be noted that in the various county subdivisions, the areas of greatest growth were within the city limits of Craig, the town limits and subdivision of Steamboat Springs, and the town limits of Rangely; Figure 22.

Moffat County: The population of Moffat County showed a steady increase in population between 1930 and 1960. Since that time, the population has decreased 7.6 percent due to changes in the mineral resources industries. However, the City of Craig, which is the county seat, grew 5.5 percent in population, resulting from the influx of rural population to the community. In the ten-year span, the proportion of the population living in rural areas within the county decreased 24.6 percent.

Rio Blanco County: The population in Rio Blanco County grew from 1940-1960, but began to decline in the 1960-1970 period. Over the past ten years, Meeker's population has dropped 3.6 percent and the population of Rio Blanco County has dropped 6.3 percent. The decline was mainly in rural areas, resulting in a six percent overall decrease with an 18.6 percent decline in rural population as previously given in Table 9. Growth between 1940-1960 was primarily due to increased oil and gas activity in the Rangely oil fields.

Routt County: Routt County population grew 11.7 percent between 1960-1970; prior to that time, the county had been declining in population. The decreases in 1950 and 1960 were caused by the decline in the mining industry; however, in 1970, the Bureau of Census recorded an urban population increase of 36.6 percent in the Steamboat Springs subdivision which is attributed directly to recreational development, rather than to mineral resource development or power plant installations which have caused recent population increases in the Hayden area west of Steamboat Springs.

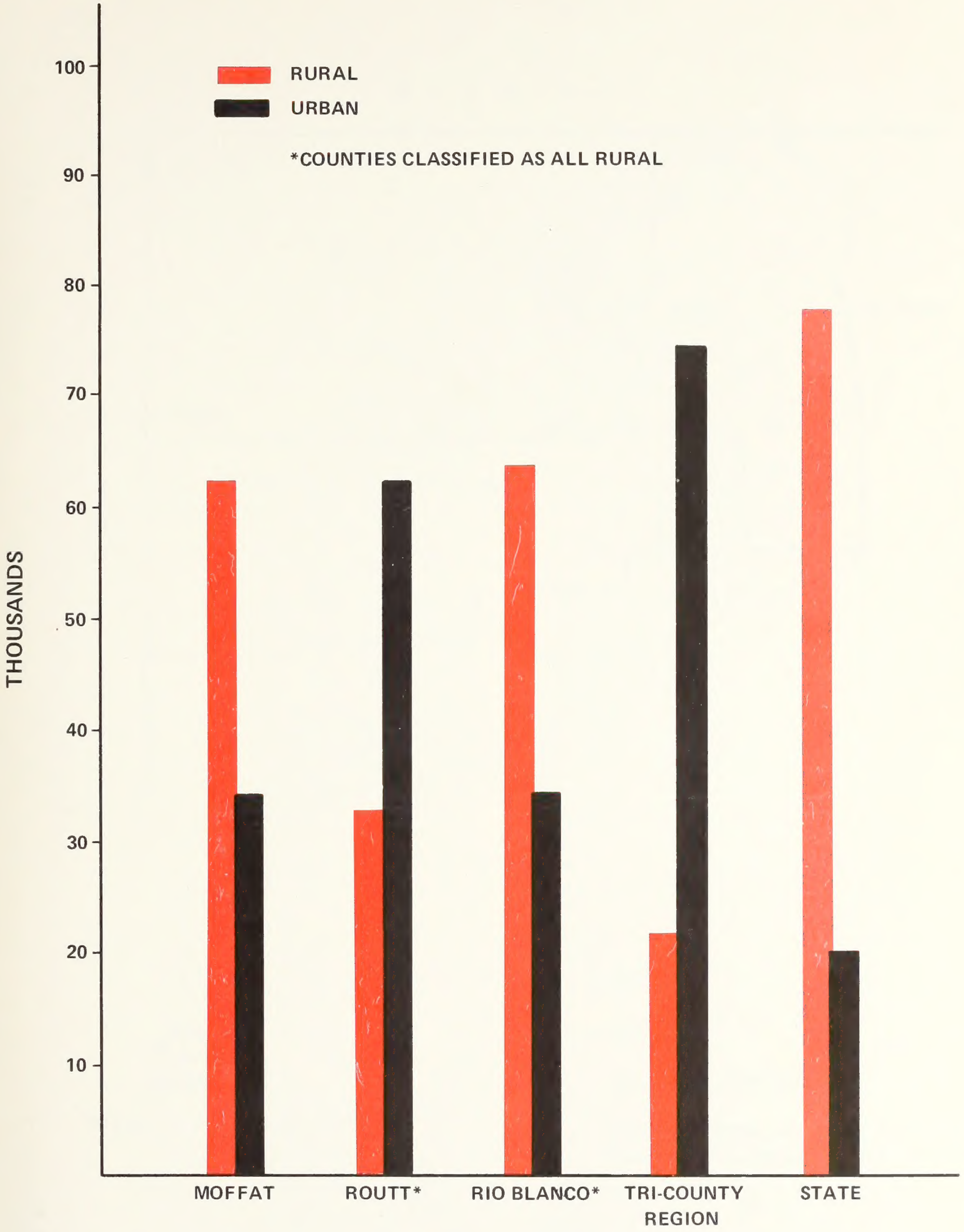
Tri-County Region: The net migration and natural increase in population for the tri-county region during the 1960 to 1970 decade is given in Table 11. Out migration accounted for a decrease of approximately 2,150 persons, while natural increase accounted for approximately 2,000 persons, resulting in a decrease of 150 persons or 12 percent decrease in population.



GROWTH PATTERN
TRI-COUNTY REGION BY COUNTIES
1920-1970

SOURCE: BLM, SOCIO-ECONOMIC STUDY, TRI-COUNTY REGION

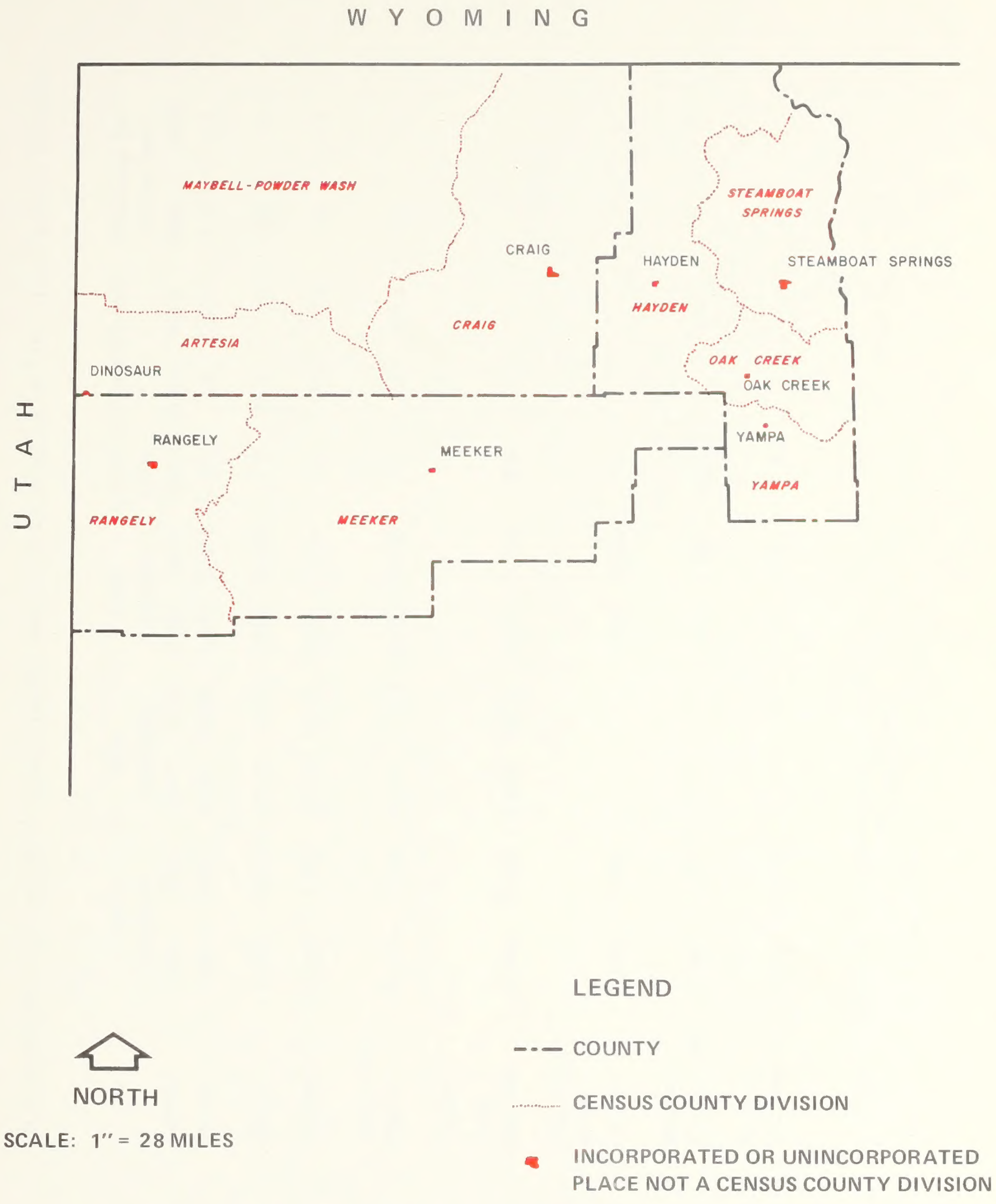
FIGURE 20



1970 URBAN - RURAL POPULATION COMPARISON

SOURCE: BLM

FIGURE 21



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COUNTY SUBDIVISION/CENSUS COUNTY DIVISION AND PLACES

SOURCE: PREPARED BY VTN

FIGURE 22

TABLE 9

POPULATION AND DENSITY FOR URBAN AND RURAL AREAS IN THE TRI-COUNTY REGION

	Total Population		Urban Population		Rural Population		Percent Change 1960-1970			Population Per Square Mile	
County	**1960**	**1970**	**1960**	**1970**	**1960**	**1970**	**Total Pop.**	**Urban**	**Rural**	**1960**	**1970**
Moffat	7,061	6,525	3,984	4,205	3,077	2,320	-7.6	5.5	-24.6	1.5	1.4
Routt*	5,900	6,592	1,843	2,340	4,057	4,252	11.7	26.9	4.8	2.5	2.8
Rio Blanco*	5,150	4,842	3,119	3,118	2,031	1,654	-6.0	2.2	-18.6	1.6	1.5
Tri-County Region	18,111	17,959	8,946	9,733	9,165	8,226	-.8	8.8	-10.2	1.8	1.7
Towns											
Craig (Moffat)	3,984	4,205	1,906	2,678	2,028	1,527	5.5				
Steamboat Springs (Routt)	1,843	2,340	**	**	1,843	2,340	-.1				
Meeker (Rio Blanco)	1,655	1,597	**	**	1,655	1,597	-3.5				
Rangely (Rio Blanco)	1,464	1,591	**	**	1,464	1,591	8.7				

*Counties are classified by Bureau of Census as rural

**Cities are classified by Bureau of Census as rural

Source: U.S. Department of Commerce, Bureau of Census

TABLE 10

POPULATION COMPARISON BY COUNTY SUBDIVISION 1960-1970 AND PERCENT CHANGE ***

County	Subdivisions	1960	1970	Percent Change
Moffat		**7,061**	**6,525**	**- 7.6**
	Artesia Division	452	360	-20.4
	Artesia Town*	318	247	-22.3
	Craig Division	6,062	5,732	- 5.4
	Craig City**	3,984	4,205	5.5
	Maybell-Powder Wash Division	547	433	-20.8
Rio Blanco		**5,150**	**4,842**	**- 6.0**
	Meeker Division	2,619	2,472	- 5.6
	Meeker Town	1,655	1,597	- 3.5
	Rangely Division	2,531	2,370	- 6.4
	Rangely Town**	1,464	1,591	8.7
Routt		**5,900**	**6,592**	**11.7**
	Hayden Division	1,237	1,201	- 2.9
	Hayden Town	764	763	- 0.1
	Oak Creek Division	1,234	1,010	-18.2
	Oak Creek Town**	666	1,192	-26.1
	Steamboat Springs Division	2,736	3,737	36.6
	Steamboat Springs Town**	1,843	2,340	27.0
	Yampa Division	693	644	- 7.1
	Yampa Town	312	286	- 8.3

*Name of Artesian Town changed in 1960 to Dinosaur Town.

**Portions of County Division annexed to Towns or Cities.

***See Figure

Source: U.S. Department of Commerce, Bureau of Census

TABLE 11
MIGRATION AND NATURAL INCREASE OF POPULATION TRI-COUNTY REGION 1960-1970

	Moffat Co.	Routt Co.	Rio Blanco Co.	Region
Total Population Change	-536	692	-308	-152
Rate of Total Population Change*	-9.0%	11.7%	-6.0%	-0.8%
Natural Increase (Births, Deaths)	932	417	664	2,013
Net Migration	-1,468	275	-972	-2,165
Net Migration Rate*	-20.8%	4.7%	-18.9%	-12.0%

*Computed with earliest year as base.

Source: U.S. Department of Commerce, Bureau of Census

The median age for the tri-county region is 29.1 years, slightly higher than the State average of 26.1 years. The 20-24 age group comprises 6.1 percent of the total population which is lower than the State average of 9.2 percent, displaying a tendency for this age group to leave the area in search of better employment opportunities which may reflect upon the availability of manpower in the area. Age group delineation is given in Appendix E.

Generally, the past population trends experienced in this area have been similar to those occurring in predominantly rural areas elsewhere in the United States. Rural populations between the ages of 21-30 years tend to migrate to employment centers in search of employment. The relatively minor percentage of out-migration from the tri-county area and the growth in Rangely, Craig, and Steamboat Springs, tend to suggest that there is in-migration from rural areas into these local employment centers. The population trends since 1970 have not been specifically recorded to date; however, increases in mineral development and related employment opportunities indicate a strong shift from the past history of declining population to one of population growth. The planning commissions in Meeker, Craig, and Rangely have indicated that the populations in their respective areas have been increasing to the extent that housing and community services are at or near maximum absorption.

Population Projections: The present mineral and mineral-related development trends in the tri-county region will cause substantial growth although the extent and range of growth is still the topic of much study and speculation. Several reports projecting population growth have been published. A thorough summary of the alternative projections and an analysis of each is found in Appendix E. The fundamental problem with forecasting population is the unknown future extent of the coal, oil shale, petroleum and power development in the region.

Several national and local events which are occurring in the energy field will play a substantial role in the growth of northwestern Colorado. These are as follows:

1) The increasing demand for energy resources and power generation

2) The lack of national oil resources

3) The federal decisions regarding the lease of federally-owned oil shale and coal properties including the Energy Minerals Allocations Recommendation System (EMARS) which for Colorado has proposed 20 new coal lease areas to be acted upon this summer by congress

4) The search for low sulfur, high BTU coal for power generation which is available in this area

5) The energy-related development by private industry currently ongoing within the tri-county planning region

6) Supportative development and planning in progress such as the proposed Lower Yampa (Juniper Dam) Project

The tri-county region is considered a prime energy resource area. Rio Blanco lies in one of the richest oil-shale regions, whereas Moffat County has extremely rich, high BTU, low sulfur, easily accessible coal deposits. Several major private industries are developing these resources to supply the necessary fuel needed locally and elsewhere in the United States to power electrical generating facilities. Because of this development, the area will become a prime new employment area which will accelerate growth both in terms of people for energy-related employment and personnel for community and service-related employment.

The areas of growth and the settlement areas will be influenced a multitude of diverse and complex factors such as:

1) Land ownership and availability of land to develop

2) Availability and expandability of utility services and facilties, such as water supply, water rights, sewer facilities, and land for solid waste disposal

3) Availability of community services, commercial services, health facilities and transportation networks

4) Secondary and supportive industrial development

5) Temporary and permanent housing

6) Distance to areas of major employment

7) Weather

Although several population projections have recently been made to the year 2000, the current events and constant changing status of mineral development in northwest Colorado, more specifically, the tri-county region, negates the probability of these projections. However, it can be accurately stated that this tri-county area will experience rapid growth within the next ten years necessitating a more thorough study of probable mineral resources and service development expected within the next ten years, to expand the available growth information given in Appendix E.

Employment and Income Characteristics

Traditionally, the economic base of the tri-county region has been predominantly agriculture and ranching, supplemented by tourism, mining and other mineral-related industries, and commercial support services. Service and retail trade provide 34 percent of the jobs within the tri-county area which rank as the two major employment sectors. Agriculture and mining provide fourteen percent and nine percent, respectively, of the employment as shown in Table 12 below.

TABLE 12

RANK AND PERCENTAGE OF EMPLOYMENT IN COLORADO AND THE TRI-COUNTY REGION

	Tri-County Region		Colorado	
Sector	**Rank**	**Percent**	**Rank**	**Percent**
Service	1	17	1	19
Retail Trade	2	17	2	18
Agriculture and Fisheries	3	14	5	7
Construction	4	10	9	5
Public Education	5	10	3	15
Mining	6	9	4	8
Public Administration	7	6	8	6
Transportation and Communications	8	4	6	7
Utilities	9	4	11	2
All Manufacturing	10	3	7	6
Wholesale Trade	11	3	10	5
Finance, Insurance, Real Estate	12	3	12	2

Source: Bureau of Land Management: Socio Economic Data System

The employment and unemployment patterns for the area compare favorably with the rest of the State, showing a lower unemployment rate of 3.6 percent as compared with the 4.0 percent for Colorado and 4.5 percent for the United States. A profile of Employment Characteristics for the tri-county region is given in Appendix E.

Moffat County: Moffat County's economic base is primarily dependent upon agriculture (cattle, sheep, dry land grains) and natural resource extraction (coal, oil, gas and timber). Although in the past Moffat County has not been a major tourist area, recreational uses and tourism are playing an increasingly important role in the County's economy. This is evident from the increased revenues generated from retail and service sectors during the tourist months. Total agricultural production in Moffat County in 1969 amounted to $7,718,000 of which $1,737,300 was crop production.

Persons employed in mining in Moffat County doubled from 200 to 400 persons in the decade prior to 1960, but declined to 124 persons by 1970, primarily due to the closing of several mines. Mining makes approximately the same contribution to the economy in terms of dollar value to production, $10,212,907 in 1972, but has declined in terms of its contribution to wages and jobs (Bureau of Land Management, 1974).

The economic activities in the County, the associated income of each in 1971 and the percentage of the total county income derived from each category are shown in Table 13. Agriculture is the largest single income source. Almost one-third of the

TABLE 13

PERSONAL INCOME IN MOFFAT COUNTY BY ECONOMIC ACTIVITY, 1971

Income Source	Amount (Dollars)	County Income (Percent)
Agriculture	$4,068,000	18
Basic & Local Services	3,996,000	18
Mining	2,550,000	11
Public Administration	2,982,000	13
Wholesale/Retail Trade	2,028,000	9
Transportation, Communication, Utilities	1,693,000	8
Manufacturing	857,000	4
Construction	377,000	2
Property Income & Net Transfer Payments	3,710,000	17

Source: Colorado Department of Employment

income in Moffat County is directly or indirectly dependent on agriculture and mining. For the tri-county area, Moffat County leads in sheep and hog production with $3,293,000 in cash receipts. The County is also the chief producer of wheat in the tri-county region, producing 48 percent and 55 percent of the region's winter and spring wheat, respectively. Agricultural development statistics for Moffat County as well as the tri-county region are given in Appendix E.

Unemployment in Moffat County was 3.5% in 1969 and 3.7% in 1971 compared to 3.7% and 4.9% for the region in the Western Area of Council of Governments. There is a seasonal aspect to employment in the County (as in the region). Of the seasonal variance in Moffat, 75% was accounted for by changes in agricultural employment (Bureau of Land Management, 1974).

Moffat County is the most affluent within the tri-county region, with the largest average per capita income of $2,759 and the highest average per household disposable income of $8,120, as shown in Table 14.

TABLE 14

SELECTED INCOME CHARACTERISTICS FOR THE TRI-COUNTY REGION

Number of Families*	Moffat	Rio Blanco	Routt	Region
Under $3,000	208	222	140	570
$3,000 - $4,999	219	245	205	669
$5,000 - $6,999	251	296	196	743
$7,000 - $9,999	420	372	338	1,130
$10,000 - $14,999	392	359	265	1,014
$15,000 - $24,999	142	148	127	417
$25,000 and over	47	49	14	110
Total	1,679	1,689	1,285	4,653
Median Income	$8,120	$7,494	$8,010	$7,841
Families Under Poverty Level				
Number of Families	208	218	130	546
Percent of Total Families	12.3%	12.9%	10.1%	11.8%
Mean Family Income	$ 778	$1,443	$1,256	$1,159
Mean Income Deficit	$1,764	$1,560	$1,836	$1,720

*Based on average per capita income

Source: U.S. Department of Commerce, Bureau of Census

Rio Blanco County: In 1970, the total labor force of Rio Blanco County averaged 1,988 persons. The largest employer was the government (both State and Federal), employing 365 persons or 19 percent of the labor force. Mining and agriculture followed closely, employing 280 persons or 14 percent, and 294 persons or 15 percent, respectively. The labor force summary for Rio Blanco County as well as for the tri-county region is given in Table 15.

Routt County: Routt County's main industry is tourism which distinguishes it from the other two counties in the region. Retail trade and services comprise 35 percent of the jobs in the County. Agriculture and fisheries employment follow in importance with 14 percent of the total employment. Of the three counties, Routt is the least affluent in terms of its per household disposable income ($7,494). It also has the highest percentage of families having incomes considered below poverty level.

Tri-County Income

A major criteria for measuring economic well being is per capita income and the rate of increase. According to the Office of Business Economics statistic analyses, total personal income in the tri-county region rose from $27,000,000 in 1960 to over $47,000,000 in 1970. During the past 10 years, total personal income in the area rose 74 percent while total personal income in Colorado increased 176 percent. The region's income has been growing but not at the same pace as other areas in Colorado, Table 16.

TABLE 16

PERSONAL INCOME AND PER CAPITA INCOME TRI-COUNTY REGION 1970

	Average Per Capita Income (In dollars)			Total Personal Income (In Million Dollars)		
	1960	**1970**	**Percent Change**	**1960**	**1970**	**Percent Change**
Moffat	1,983	2,759	*39.0*	14	18	*29*
Routt	1,525	2,579	*69.1*	9	17	*89*
Rio Blanco	777	2,478	*219.0*	4	12	*199*
Region	1,491	2,617	*76.0*	27	47	*74*
Colorado	1,885	3,118	*65.0*	2,497	6,883	*176*

Source: Office of Business Economics

TABLE 15

LABOR FORCE SUMMARY
TRI-COUNTY REGION
BY PERCENT AND NUMBER OF FAMILIES
1970

Labor Force	Moffat County Number	Moffat County Percent	Routt County Number	Routt County Percent	Rio Blanco County Number	Rio Blanco County Percent	Tri-County Region Number	Tri-County Region Percent	Colorado Number	Colorado Percent
Total Labor Force Over 16 years	2,639		2,619		1,988		7,246		909,581	
Unemployment	137	5.2	86	3.3	42	2.1	265	3.6	36,383	4.0
Agriculture & Fisheries Emp.	351	14.0	362	14.0	294	15.0	1,007	14.0	38,093	5.0
Mining	124	5.0	175	7.0	280	14.0	579	9.0	14,232	2.0
Construction	294	12.0	232	9.0	152	8.0	678	10.0	54,668	7.0
All Manufacturing	42	2.0	95	4.0	42	2.0	179	3.0	120,581	15.0
Furniture & Lumber Manufacturing	21	0.8	42	2.0	0	N/A	63	0.8	3,917	0.4
Food-Kindred Manufacturing	9	0.3	0	N/A	0	N/A	9	0.1	16,043	2.0
Transportation-Communication	97	4.0	130	5.0	32	2.0	259	4.0	45,838	6.0
Utilities	88	4.0	98	4.0	62	3.0	248	4.0	14,840	2.0
Wholesale Trade	127	5.0	26	1.0	53	3.0	206	3.0	37,798	5.0
Retail Trade	501	20.0	515	20.0	219	11.0	1,235	17.0	145,447	18.0
Services	472	19.0	391	15.0	346	18.0	1,209	17.0	155,030	19.0
Finance, Insurance & Real Estate	54	2.0	73	3.0	56	3.0	183	3.0	46,399	6.0
Public Education	193	8.0	224	9.0	212	11.0	629	10.0	63,430	8.0
Public Administration	136	5.0	110	4.0	153	8.0	399	6.0	54,900	7.0

Source: U.S. Department of Commerce, Bureau of Census

The average per capita income in the region increased from $1,491 to $2,617 during the period between 1960-1970, or 76 percent. Although this growth has been greater than the state, which rose 65 percent, the average per capita income for the tri-county region was still, although not significantly, lower than the state average by $501. This indicates that the tri-county region per capita income is increasing but has not caught up with the state average due to the overall shift in employment from agriculture to industrial or retail trades. Table 17 delineates the median income for the tri-county region by occupation and for the state. The average median earnings for the tri-county region are considerably lower than that of the state as a whole, especially when comparing male professional earnings.

Earnings by industrial sector include wages, salaries, other labor income and proprietor's income (net income of self-employed persons) and include approximately 80 percent of the total personal income generated in the tri-county region. Property income and transfer payments account for the remaining 20 percent. The most important economic sectors, regionally, in order of importance from the standpoint of income earnings produced are: 1) Agriculture, 21.0% 2) Government, 17.1% 3) Mining, 16.9% 4) Trade, 13.0% 5) Services, 12.2% 6) Construction, 8.6% 7) Public Utilities, 4.0% 8) Transportation, 3.1% 9) Manufacturing, 2.3% 10) Finance, 1.8%.

Total employment in the mineral extraction sector (Table 15) is about 579 people, or about 9.0 percent of the tri-county regional employment. It is not possible to accurately separate employment for the mineral industry into employment by type of mineral for the area. Some reasonable judgements, however, regarding employment by mineral resource can be made. Based upon other available information, it is safe to assume that most of the industry's employment in Moffat and Rio Blanco Counties comes from petroleum and natural gas production. In Routt County, however, most of the employment is attributible to coal.

Employment and Income Associated with Mining Development

The history of employment and income associated with the mining industries has been a "peaks and valleys" situation dependent upon the demand for coal. Prior to 1966, there were 19 operating coal mines in the corridor study area. As of 1966, one was in operation. At the present there are three operating mines, none of which were previous operating mines.

However, due to the increased interest in the low sulfur coal in this area and elsewhere in the tri-county region, the mining industry is due to increase the number of mines and the amount of tonnage produced within the next few years. Since the decrease of mining activity in 1966, employment declined in this field causing, also, a decline in population in the major towns in the area; Meeker and Craig in particular.

TABLE 17

SELECTED EARNINGS FOR THE TRI-COUNTY REGION AND THE STATE 1970

Median Earnings	Moffat County	Routt County	Rio Blanco County	Tri-County Area	Colorado
MALE	$7,003	$5,750	$6,367	$6,373	$ 7,495
Professional, Managerial, etc. Workers	$9,196	$7,480	$8,897	$8,524	$10,376
Craftsmen, Foremen, etc.	$6,911	$6,962	$7,987	$7,287	$ 7,966
Operatives, Incl. Transport	$7,164	$5,623	$5,590	$6,126	$ 6,673
Laborers (Ex. Farm)	$5,688	$4,259	$6,792	$5,580	$ 4,759
Farmers and Farm Managers	$3,326	$3,875	$3,417	$3,539	$ 4,726
Farm Laborers and Foremen	$2,304	$2,150	$3,757	$2,737	$ 3,208
FEMALE	$2,763	$2,139	$2,402	$2,435	$ 3,468
Clerical and Kindred Workers, etc.	$3,404	$3,213	$2,646	$3,088	$ 4,038
Operatives, Incl. Transport	N/A	$1,281	N/A	$1,281	$ 3,236

Source: U.S. Department of Commerce, Bureau of Census

Table 18 gives the 1972 income rates for employees engaged in mining activities for the United States and Colorado. Table 19 gives the 1960 and 1970 employment and income figures for the tri-county region for mine workers in the State of Colorado. The increase in income between 1960 and 1970 is not as marked as that from 1970 to 1972 due to recent inflation and also due to the unavailability of trained manpower in the mining field. The lack of manpower is primarily due to the lack of coal mining activity. With the reoccurring interest in coal, employment opportunity and interest in mining as an occupation will increase dramatically until the labor market reaches saturation. The actual level of opportunities or job availability for the tri-county region is not accurately known at this time.

TABLE 18

AVERAGE SALARIES BY OCCUPATION FOR THE COAL MINE INDUSTRY IN THE UNITED STATES AND FOR THE MINERAL INDUSTRY FOR THE STATE OF COLORADO 1972

Occupation	**Median Salary**
U.S. Coal Mine Industry	
All Workers	$11,293
Management and Office	13,453
Production, Development, Exploration	10,916
Colorado Mining Industry*	
All Workers	$11,473
Management and Office	13,543
Production, Development, Exploration	10,379

*For general industry, figures not available by specific mining industry or by product

Source: U.S. Department of Commerce, Bureau of Census, Industrial Division John McNamee, Chief Minerals Branch

Employment and Income for the Projected Colowyo Mine Development

Table 20 gives the projected employment by occupation for the proposed Colowyo Mine. It should be noted that this does not include construction employees. The construction will be performed by subcontract work. Based upon similar mining operations, it is estimated that 100 construction workers will be needed to construct mining facilities.

TABLE 19

PROFILE OF MINE WORKERS
STATE OF COLORADO, 1960 AND 1970

	1960			1970		
Employee Groupings	Male	Female	Total	Male	Female	Total
Total Employees	13,692	903	14,250	12,644	1,847	14,491
Total White	–	–	14,069	–	–	12,999
Total Non-White	–	–	181	–	–	1,493
Earnings in Dollars						
$1 to $999	427	89		596	174	
$1,000 to $1,999	778	64		717	339	
$2,000 to $2,999	858	73				
$3,000 to $3,999	1,717	212		502	296	
$4,000 to $4,999	2,311	270		785	270	
$5,000 to $5,999	2,457	136		1,056	311	
$6,000 to $6,999	1,713	39		1,755	185	
$7,000 to $9,999	2,198	16		2,508	175	
$10,000 and over	1,233	4		2,916	87	
Median Earnings (in dollars)	$5,307	$4,050		$8,726	$5,424	

Source: U.S. Department of Commerce, Bureau of the Census

TABLE 20

PROJECTED EMPLOYMENT BY OCCUPATION FOR THE PROPOSED COLOWYO MINE

	Number			Number	
Management Occupation	**Phase 1**	**Phase 2**	**Labor Occupation**	**Phase 1**	**Phase 2**
General Manager	1	1	Drillers and Helpers	2	12
Superintendent and Assistant	1	2	Shooter and Helpers		8
Pit Foreman	2	7	Dragline Operator	2	12
Drill and Shoot Foreman	0	2	Dragline Oiler	2	12
Tipple Foreman	2	2	Groundmen	2	8
Electrical Foreman	0	2	Loader Operator	1	2
Maintenance Foreman	2	4	Loader Oiler	1	2
Engineers	1	2	Front End Loader Operator		
Engineering Aide	1	1	(Incl. Coal)	3	8
Transitman	1	1	Truck Drivers, Coal & Service	27	28
Rodman	1	1	Skidder Operator	1	3
Analyst	1	1	Bulldozer Operator	3	12
Accountant	1	1	Grader Operator	1	2
Purchasing Agent	1	1	Welders & Helpers	5	8
Payroll and Cost Clerk	1	1	Mechanics	6	6
Shipping and/or Supply Clerk	1	5	Electrician	3	5
Stenographer	1	1	Laborer	3	3
Watchman	3	2	Tipple Operator	4	4
			Tipple Mechanic	2	2
			Tipple Laborer	4	2
			Carpenter	0	1
Subtotal	21	38	Subtotal	72	148
	Phase I			Phase II	
Total all Employees	93			186	

Source: Colowyo Coal Company, a division of W. R. Grace & Co.

Average per capita employee income should be similar to the United States and State of Colorado Mining Industry median incomes.

Community and Social Services

Housing Characteristics: Various housing characteristics for the Tri-County Area are tabulated in Appendix E. During the 1960-1970 period the number of housing units increased in the region while the population dropped eight tenths of a percent. Some of this housing expansion, ten percent increase in units, could be attributable to seasonally used condominiums in the Routt County Area; Table 22.

Persons per occupied unit compared favorably with the state, both are approximately three persons per occupied unit. Nine percent of all homes in the region are mobile homes, the largest percentage being in Rio Blanco County. Seventy-eight percent of all housing units in the tri-county in 1970 consisted of only one unit per structure, mostly single family homes, Table 21, with nearly 80 percent of all houses built before 1960, indicating very little new construction before 1970.

A majority of housing units in the tri-county region are hooked to a public system for water and sewage and 60 percent are on public sewers. Routt County has the fewest percentage of units with either type of system (Bureau of Land Management, 1974).

TABLE 21

NUMBER OF YEAR-ROUND HOUSING UNITS PER STRUCTURE IN TRI-COUNTY AREA 1970

Units In Structure	Moffat County	Routt County	Rio Blanco County	Region
One	1,890	2,291	1,450	5,631
Two	79	68	106	253
Three-Four	137	51	31	219
Five or More	155	255	78	488
Mobile Homes	199	234	216	649
TOTAL	2,460	2,899	1,881	7,240

Source: U.S. Department of Commerce, Bureau of Census

TABLE 22

HOUSING INVENTORY BY COUNTY, 1960-1970 BY TYPE AND TENURE

	Moffat County	Rio Blanco County	Routt County	Tri-County Region	Colorado
1970 Population	6,525	4,842	6,592	17,959	2,207,259
1960-70 Population Change-Percent	-9.0%	-6.0%	11.7%	-0.8%	26%
1960 Housing Units	2,426	1,944	2,508	6,878	594,522
1970 Housing Units	2,490	2,028	3,092	7,610	757,070
1960-1970 Change in Total Housing Units	2.6%	4.3%	23.3%	10.6%	27.3%
1970 Vacant & Migratory Units	66	147	193	406	15,420
All Year-Round Units 1970	2,460	1,881	2,899	7,240	745,858
Owner Occupied	1,407	904	1,533	3,844	438,148
Renter Occupied	672	570	626	1,868	252,780
Vacant Year-Round	381	407	740	1,528	51,930
Persons Per Occupied Unit	3.0	3.1	3.0	3.0	3.1
Persons Per Owner Occupied Unit	3.0	3.1	3.1	3.1	3.3
Persons Per Renter Occupied Unit	3.0	3.3	2.9	3.1	2.6
Population in Housing Units (1970)	6,222	4,641	6,517	17,380	2,123,257

Sources: Detailed Housing Characteristics, Bureau of Census; Colorado Housing: Current Inventory and Needs—1972.

In the tri-county region, the majority of people have lived in the same home for over 20 years. In 1970, over 60 percent of the owner-occupied units were valued at less than $15,000, compared with less than 38 percent for the state; 55 percent of renter-occupied units were in the under $100 per month gross rent group.

Since 1970, this trend in housing has changed and continues to do so due to the amount of growth which has occurred in Rio Blanco County around Rangely and Meeker, in Routt County near Steamboat Springs and in Moffat County around Craig. This growth brings mobile home parks and increased valuation of existing homes.

Housing Inventory: The Colorado-Ute Power project employees have added to the severe housing shortage in Craig, a shortage which may be perpetuated with new development.

In Craig, one mobile home park owned by the Craig East Development Company, has already committed many of the spaces to Sterns-Rogers for construction workers at the Utah International Mine. Prices are high and stipulations state that trailers must be purchased directly from the developers. The Riford developers who plan a 210 dwelling unit development west of Craig have had preliminary plans passed and their public hearing with the Planning Commission was June 28. The development includes a park area and a 10-acre school site.

The Moffat County Developers have planned a 41.5 acre mobile home park with 200 spaces, a 42.3 acre commercial development, and a housing development for 43 multi-family units (150 duplexes or family units and 200 apartments). This plan is pending preliminary approval by the planning commission. The public hearing with the Board of Planning Commissioners is scheduled for July 1. One anticipated problem according to Judy Steele of the Planning Department could be the location of the site which is a flood plain area.

By the end of the summer, 40 new BLM employees will need housing in Craig. According to Ed Parsons, Resources Economist, BLM, Denver, Colorado, and Bruce Conrad, BLM, Craig, Colorado, federal land may have to be used to build federal housing for these families since no housing is available. More public assistance may be necessary if the housing problem becomes much worse.

Rio Blanco County's two population growth centers, Meeker and Rangely, are experiencing similar severe housing shortages. The principal housing needs are in the middle and low income ranges, the greatest need in the region appears to be housing which rents for $100 a month, and for homes which can be purchased in the $15,000-$20,000 range. Duane Rehborg, County Planner,

stated that the A. Craig Company's plans for their 180-acre annexation was not yet known and the other major developer, notably Berry Brothers of Kansas City, who hold several thousand acres, were giving no indication of when they would present development plans. The Fairfield Complex, said Rehborg, 24 federally-subsidized units, "will not begin to make a dent in the need for housing for low-income families". The availability of permanent housing does not look good for the coming year. New offices are being constructed; two buildings with a total of 24 units.

Routt County is experiencing similar housing problems as the rest of the tri-county area, particularly in the community of Hayden. The employees of the Utah International Mine scheduled to supply the Colorado-Ute Power Project will be joined by mining employees from other proposed projects within two years. The shortage of housing will become worse in a few years unless a great deal of planning and development takes place.

In an attempt to reduce its housing shortage, Hayden has made two new annexes in the past year which may be developed. Hayden's housing shortage is causing some pressure on Steamboat Springs. In 1972, of the 1026 units that were constructed in Routt County, 400 were in Steamboat Springs.

Utilities: The town of Meeker (Rio Blanco County) provides an aeration sewer system which has a capacity of 275,000 gallons per day, and which is being expanded to provide an 800,000 gallon per day sewage capacity. This expansion will depend upon EPA funding and is scheduled to begin in May, 1975. Due to irrigation, water consumption is presently 1.3 million gal/day in the summer and 0.5 million gal/day in the winter. The system capacity is about 1.3 million gal/day.

The City of Craig (Moffat County) obtains its water from the Yampa River and has a capacity of 15.5 million gal/day. The city presently utilizes about five million gal/day. Sewage treatment is domestic aeration which is in the process of being changed to post clorination. The additional equipment will provide adequate treatment for a city of 10-13,000 people under ideal conditions according to the water plant superintendent, Mr. Bower, and the distribution system is inadequate even for present needs. Landfills are no problem; the projected capacity is 50 years. Electricity is supplied by the Yampa Valley Electric Association, and gas through the Greeley Gas Company. Other services include garbage collection, telephone and telegraph service.

The sewage system for Steamboat Springs (Routt County) serves a population of 3,000 in summer and 10,000 in winter. The capacity is for 7,500 people and is thus inadequate for the winter and spring usage. The Steamboat Springs-Hayden area facilities will not take care of a large permanent employee inmigration.

Water capacity is 1.78 million gal/day, however, in spring 18.5 million gal/day are utilized for irrigation purposes. It is estimated by the county planner that 250 new housing units could be hooked on to the present system without overloading the facilities.

Social Services

Police and Fire Services: It is anticipated that the expansion of certain kinds of social services, such as police and fire protection, will be necessary to provide for future development. A recommended ratio of law enforcement officers to population is 1.9 officers per 1,000. Moffat County and the City of Craig have seven full-time officers, including one part-time officer, and one investigator (plus a county sheriff, five deputies and three jailers) which is a ratio of 1.9 officers per 960 persons. The City has two patrol cars; the county has a pickup and three cars; the jail has 24 cells. There will be a need for approximately 27 law enforcement officers by 1977 (1.9 per 1,000), and five cars to handle growth due to the Colorado-Ute Power project alone. Jail facilities will be adequate for the existing projected growth.

Fire protection is provided by the Moffat County Fire Protection District. Equipment consists of a 1,000-gallon-per-minute pumper, a 750-gallon-per-minute pumper, two four-wheel-drive brush-fire trucks, and a 1,200-gallon tanker. A volunteer force of 20 men train regularly and respond to ambulance calls with two ambulances.

Future needs depend upon growth, the kind of system selected, and level of protection. Moffat County's Fire Insurance Rating is 8, which is inadequate for the present population; they could easily afford a class 7. According to Jack Riegel of Codescott Insurance Agency, once a city reaches a population of 5,000 a paid fire department is practically mandatory. As expansion occurs, the County will wish to raise its rating and provide a permanent fire protection staff.

The town of Meeker (Rio Blanco County) has a staff of three policemen and two patrol cars. Rio Blanco Coutny has four police personnel and three patrol cars. There is adequate service available for the town of Meeker, however, an increase of two policemen is needed to provide adequate police protection for the county.

Fire protection in Meeker consists of 30 volunteers and five trucks including one ladder, one pumper, and one emergency vehicle. The fire insurance class is 8, which is adequate for the city's present needs.

Medical Services: The hospital in Craig has 34 beds at present, which is adequate for current needs. The U. S. average for

hospital beds is 7.9 per 1,000 population, and the Colorado average is 7.2 per 1,000 population. Craig has 7.5 beds per thousand population. Using a constant, an additional 37 beds would be needed to provide for future growth resulting from known mineral related activities.

Moffat County has five doctors and two dentists, which is inadequate when compared with the suggested doctor patient ratio. Nursing home capacity is adequate, and since most population growth will be in active age groups, additional demands will be few.

The Meeker Community hospital has a 20 bed capacity. Medical facilities include one nursing home, 24-hour ambulance service, and two pharmacies. The community has two doctors and one dentist. The County has five doctors and two dentists, and more are needed to provide an adequate medical program.

Community Services: The services and retail trades sectors together are the largest source of employment, (34 percent), in the tri-county region. It should be noted that retail services usually provide the major employment sector since there is a ratio of 1.5 service personnel per employee hired in a non-service industry. The Department of Commerce reports that 210 service establishments recorded receipts of $4,875,000 in 1967. Since then the service industry has grown considerably with total receipts for fiscal year 1972 at over $6 million, particularly due to the new establishments. Selected services are given in Table 23.

Table 24 shows retail sales by business groups for 1972. Automotive dealers and service stations accounted for over 19 percent of the total retail sales in terms of dollars, while food stores accounted for another 13 percent. In 1973, all counties increased their retail sales, Moffat County by 14.1 percent, Rio Blanco County by 3.5 percent and Routt County by 23.2 percent (Bureau of Land Management, 1974).

Education: Children from families employed in the Colowyo Mine will attend schools in either Moffat or Rio Blanco Counties. The project site itself lies within the boundaries of the Moffat County School District REI. The school district boundaries are delineated in Figure 23. Table 25 presents a profile of school district REI.

This district includes one high school (grades 9-12), one junior high school (grades 6-8) and three elementary schools (grades K-6), all of which are located in the city of Craig. Sunset Elementary School covers kindergarten through grade 4. Breeze Elementary School covers grades 4 and 5 only, and East Elementary School covers kindergarten through grade 3. In addition to these, there are five rural elementary schools scattered throughout the county.

TABLE 23

SELECTED SERVICES
TRI-COUNTY REGION
1967

Establishments	**Moffat County**	**Routt County**	**Rio Blanco County**	**Tri-County Region**
Hotels, Motels and Tourist Courts	32	29	18	79
Personal Services	19	13	14	46
Misc. Business Services	4	2	4	10
Motion Pictures	1	1	1	3
Other Amusement, Recreation	5	4	6	15
Auto Repair, Auto Services, Garages	14	*	9	23
Misc. Repair Services	12	8	14	34
Total Establishments	87	57	66	210
Total Receipts ($1,000)	$1,905	$1,387	$1,583	$4,875
Total Payroll ($1,000)	$ 390	$ 347	$ 424	$1,161
No. Paid Employees	112	120	75	307

Source: U.S. Department of Commerce, Bureau of Census.

TABLE 24

SALES TAX: RETAIL SALES BY BUSINESS CLASS
FISCAL YEAR 1972
(Thousands of Dollars)

Area	Moffat County	Routt County	Rio Blanco County	Tri-County Region	Colorado
Agriculture, Forestry, Fisheries	184	96	0	(0.3) 280	(0.4) 39,100
Mining	1,246	63	3	(1.8) 1,312	(0.2) 25,430
Contract Construction	467	858	405	(2.4) 1,730	(2.6) 262,772
Manufacturing	2,374	938	284	(5.0) 3,596	(14.1) 1,380,727
Transportation, Communication, Electrical, Gas & Sanitary Services	1,364	2,858	1,796	(8.4) 6,018	(5.1) 1,498,101
Wholesale Trade	3,227	1,062	2,672	(9.7) 6,961	(9.9) 972,722
Building Materials, Farm Equipment	1,419	3,624	1,158	(8.6) 6,201	(5.4) 526,925
General Merchandise	513	582	415	(2.1) 1,510	(6.5) 633,573
Food Stores	3,754	3,719	1,826	(13.0) 9,299	(11.5) 1,124,577
Auto Dealers & Service Stations	7,149	4,616	1,852	(19.1) 13,617	(16.8) 1,646,013
Apparel & Accessories Stores	854	1,043	170	(2.8) 2,067	(2.3) 229,921
Furniture & Home Furnishings Stores	538	184	540	(1.7) 1,262	(2.8) 280,755
Eating & Drinking Establishments	1,172	2,224	507	(5.4) 3,903	(5.3) 521,900
Misc. Retail Stores	2,028	3,341	1,337	(9.4) 6,706	(8.4) 825,304
Financial, Insurance & Real Estate	0	123	3	(0.1) 126	(0.1) 14,416
Hotels & Other Lodging Places	869	2,616	272	(5.2) 3,757	(1.6) 161,518
Services Other Than Lodging	982	1,079	826	(4.0) 2,887	(5.2) 509,656
Government Facilities	0	18	0	(0.05) 18	(0.05) 5,280
Non-Classifiable Establishments	0	41	*	41	(0.1) 11,176
Totals	**28,140**	**29,085**	**14,067**	**71,292**	**9,739,864**

*Less than $500

( ) = Percent of Total Retail Sales

Source: Annual Report, Colorado Department of Revenue, 1971-1972

TABLE 25

PROFILE OF MOFFAT COUNTY UNIFIED SCHOOL DISTRICT RE1

School	Grades	Present Enrollment	Capacity	No. Teachers	Location	Condition of Buildings
Moffat County High School	9-12	534	540	32	Craig	poor (needs to be replaced)
Junior High School	6-8	443	550	25	Craig	good (6 yrs. old)
Sunset Elementary	K-4	350	400	25	Craig	fair (15 yrs. old)
Breeze Elementary	4&5	190	250	10	Craig	poor (needs to be replaced)
East Elementary	K-3	194	220	8	Craig	fair (15 yrs. old)
	Total	1,711				

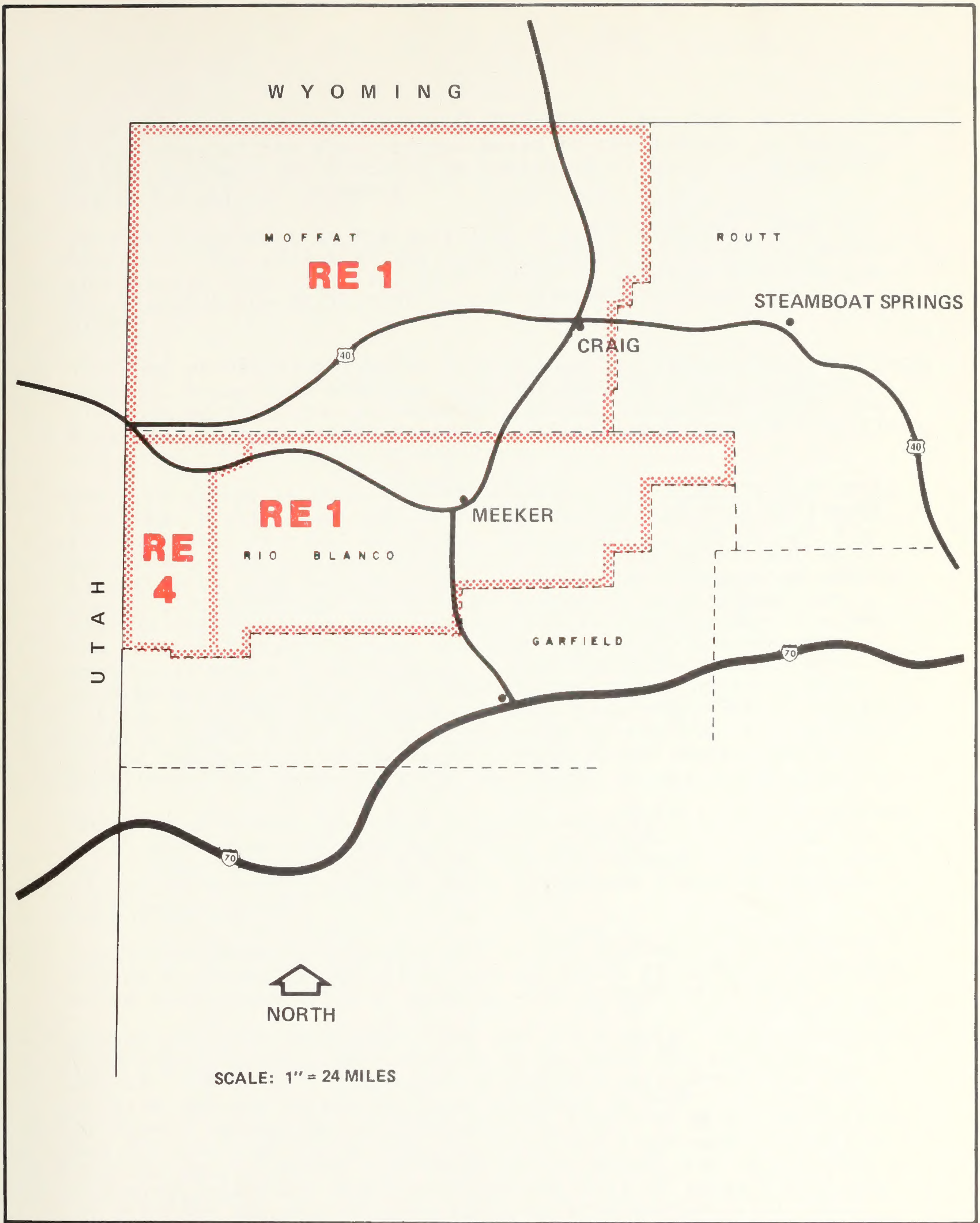
Source: Prepared by VTN.

TABLE 26

PROFILE OF RIO BLANCO UNIFIED SCHOOL DISTRICT RE1

School	Grades	Present Enrollment	Capacity	No. Teachers	Location	Condition of Buildings
Meeker High School	10-12	230	300	10	Meeker	good
Junior High School	7-9	120	140	8	Meeker	fair (needs to be replaced)
Elementary School	K-6	320	370	16	Meeker	good

Source: Prepared by VTN



vtn

SCHOOL DISTRICT BOUNDARIES
MOFFAT AND RIO BLANCO COUNTIES

SOURCE: PREPARED BY VTN

FIGURE 23

High school and junior high school students residing in the outlying areas of the district are bused to the schools in Craig. At the present, the district is utilizing 27 buses to transport approximately 600 students.

Present enrollment in the district is 1,800 students, with 113 teachers. The office of the Superintendant of Schools estimates the average classroom size to be about 22 students which is comparable with the 23.1 students per classroom average for the State.

The town of Hamilton (Moffat County) has one elementary school only which is a two-room building with one teacher and 13 students. The town of Lloyd has no schools. Students from both towns are bused to the high school in Craig. Elementary students from Lloyd are bused to the school at Hamilton.

The high school is presently filled almost to capacity but it is felt that 4 classrooms in the administration building will meet the needs for the fall of 1974. The district plans to build a new high school building within the next three years, but at this time no bond issue has been raised. The junior high school was built 6 years ago and will be expanded, if necessary, to include classrooms in the old high school building when the new one is constructed. Sunset and East Elementary Schools were both built about 15 years ago. Sunset Elementary School will incorporate 12 classrooms in the Administration Building once outside exits are constructed. Breeze Elementary School is considered obsolete and the district plans to replace it, but there are no immediate plans to do so. Table 26 outlines present enrollments and capacities for the Moffat County School District.

The town of Meeker is served by Rio Blanco Unified School District REI. Boundaries are also delineated in Figure 23. Within the city limits are one high school, one junior high school and one elementary school. Another small elementary school is located at Piceance Creek.

Total enrollment in the district is 700 students. Students residing a maximum of 48 miles away are bused to schools in Meeker, which represents about 32 percent of the total enrollment.

Rangely College, located in the town of Rangely, is a public two-year school serving the Counties of Jackson, Routt, Moffat, Rio Blanco, and Grande. It offers a complete vocational training program and has especially good programs in dental hygiene and aerospace technology. At the present time, there are no programs for any phase of the mining industry, and there are no plans for the implementation of such programs. However, the vocational training department did express an interest in working with new or existing industry to form training programs to fit technological needs.

Table 26 presents a profile of the schools in Meeker including present enrollments and the capacities of existing facilities. The high school building is in good condition, but it is felt that eight more classrooms must be added to adequately meet future needs.

The junior high school building is 50 years old and in poor condition. At the present time the Rio Blanco district is investigating the possibility of constructing a new building. Funds are not available now, and a bond issue will have to be proposed or a source of federal monies found.

The elementary school building is in good condition and will be able to facilitate projected growth for the next few years.

Recreation: The tri-county region offers a wide variety of outdoor recreation and cultural facilities that can be enjoyed by incoming population resulting from mineral resources development.

The abundance of forests and lakes provides many types of fishing, hunting, skiing in the winter, and camping, boating, water skiing, golfing, and hiking in the summer. Figure 24 shows the major recreational areas within a days' driving distance from the proposed Colowyo Mine site.

Several ski areas are easily accessible throughout the region. The Steamboat Springs ski area is 42 miles east of Craig. Aspen is within 100 miles of Meeker. The Sunlight ski area is 10 miles south of Glenwood Springs on Colorado Highway 82 off I-70. Howeesen Hill and Steamboat Springs are two miles northeast of the city of Steamboat Springs on U.S. 40 and 40 miles east of Craig.

Several national forests and primitive areas lie within easy access of Meeker, Craig, and Rifle. These forests contain all manner of year-round outdoor recreation and provide steady tourist revenue. The eastern portion of Rio Blanco County lies within the White River National Forest containing facilities for fishing, hunting, camping, hiking and skiing.

About 50 miles east of Meeker, on State Highway 132, is the Flat Tops Primitive Area in the White River National Forest. A few of the many lakes in the area are Trappers Lake, Marvine, Wall and Skinny Fish, which provide excellent fishing.

Dinosaur National Monument is located 60 miles west of Craig and about 50 miles northwest of the mine site. The area, encompassing about 209,744 acres, contains spectacular fossil remains. Canyons and rock formations have been formed by the Green and Yampa rivers in the monument area. River boat trips are available here as well as nature walks in the summer at the Split Mountain Gorge Campground.

The Routt National Forest, lying astride the Continental Divide, is a region of highly productive watershed, trout streams, and alpine lakes. It contains 39 camp and picnic areas, as well as many scenic vistas such as Mount Zirkel Wild Area. Saddle and pack trains into this area can be arranged.

The State maintains several recreational areas that also provide year-round sports activity. Island Acres and Vega Reservoir, just outside of Palisade and ten miles east of Grand Junction, respectively, offer camping, fishing, water skiing, and spectacular scenery. Rifle Gap Reservoir and Rifle Falls Recreational Area lie immediately north of Rifle.

There is an abundance of lakes in the region that offer excellent fishing and water sports. Besides those mentioned in the various national and state areas, there are numerous other facilities, such as Hart and Trappers Lakes, located 40 miles east of Meeker. Rifle Mountain Park, maintained by the City of Rifle extends for two miles along Rifle Creek. Blanco Lake is located west of Meeker and Lake Avery, in the Big Beaver Reservoir recreation area, and offers water skiing and swimming.

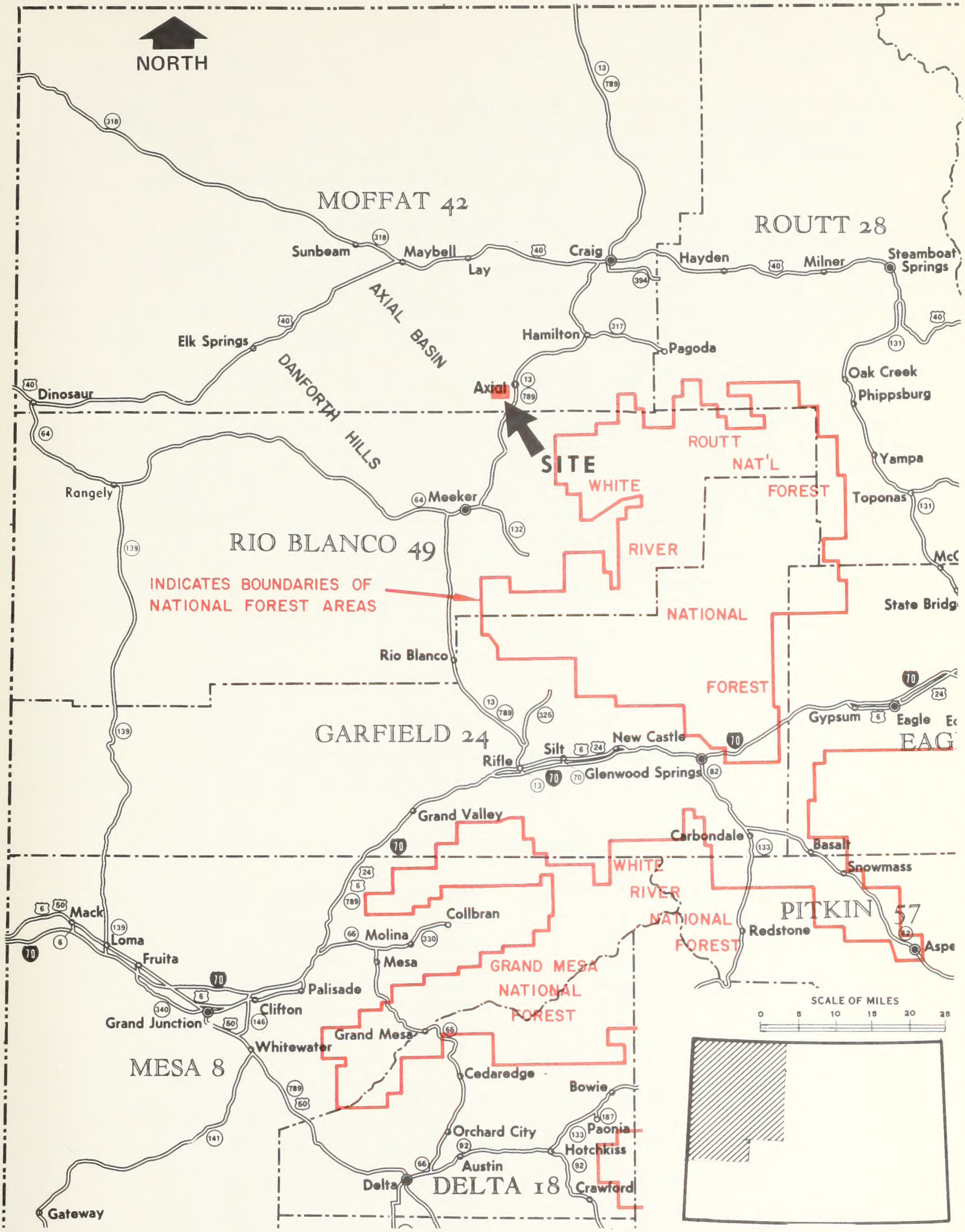
The tri-county region contains some of the best hunting in Colorado. Among the hunting areas closest to the proposed mine site are the Vega Recreation Area, South Fork, and Deep Lake in the White River National Forest and Hahns Peak Lake and Box Canyon in the Routt National Forest as delineated on Figure 24.

In the big game season in the fall, deer, elk and occasionally bear are available. Antelope season is in September. The Meeker area is equally plentiful with elk and deer.

The area has much to offer in the way of interesting local sights, scenic tours, and cultural events. The Range Call Celebration, held each July 4th and 5th in Meeker, is one of Colorado's oldest rodeos. Craig has one of the finest rodeo grounds and race tracks in Colorado.

The Meeker Massacre Site is four miles west of Meeker. The Meeker Historical Museum is in the old Fort Building in Town Square. Meeker is about to get a 500 to 600 capacity convention hall and is presently working for designation as a pioneer village in 1976. They will go before the Heritage Committee either in June or July and have already submitted for their 701 funds through the Advisory Committee and the Colorado association of Governments.

The proposed Elkhead Recreation Area, which will be located northwest of Hayden and northeast of Craig, is due for completion in two years. It will encompass approximately 400 acres, lying on the Elkhead River on the Moffat-Routt County line. It is being build around a reservoir being constructed by both the Colorado-Ute Power Association and the Colorado Division of



RECREATIONAL AREAS ADJACENT TO THE PROPOSED COLOWYO MINE SITE

SOURCE: COLORADO STATE DEPT. OF HIGHWAYS, 1974

FIGURE 24

Wildlife. Although the exact nature of the recreational activities is undecided, the area will be managed by the Division of Wildlife, and it is thought by them that facilities for camping, hiking and boating will be built.

Transportation: The proposed mine site is located on Colorado Highway 13, one of the primary routes through Rio Blanco and Moffat Counties. The approximate driving distance from Meeker to the site is 20 miles, and 27 miles from the site to Craig. Meeker and Craig, the two main communitites in the vicinity of the site, are both located on this highway.

Figure 25 and Table 27 present traffic volume figures for 1972 for roads and highways between Grand Junction and Craig. The stretch of highway between Meeker and Craig is not a well travelled area by normal traffic (refer to Table 27), and at this time only two other coal mines in the area are hauling or are planning to haul coal. The Silengo Coal Mine (Empire Energy Coal) is located seven miles south of Craig at the junction of the Williams Fork and the Yampa Rivers. From this mine, eight to ten coal trucks make approximately 35 trips a day, varying with the daily coal production, to the depot south of Craig where the coal is transferred to hopper cars.

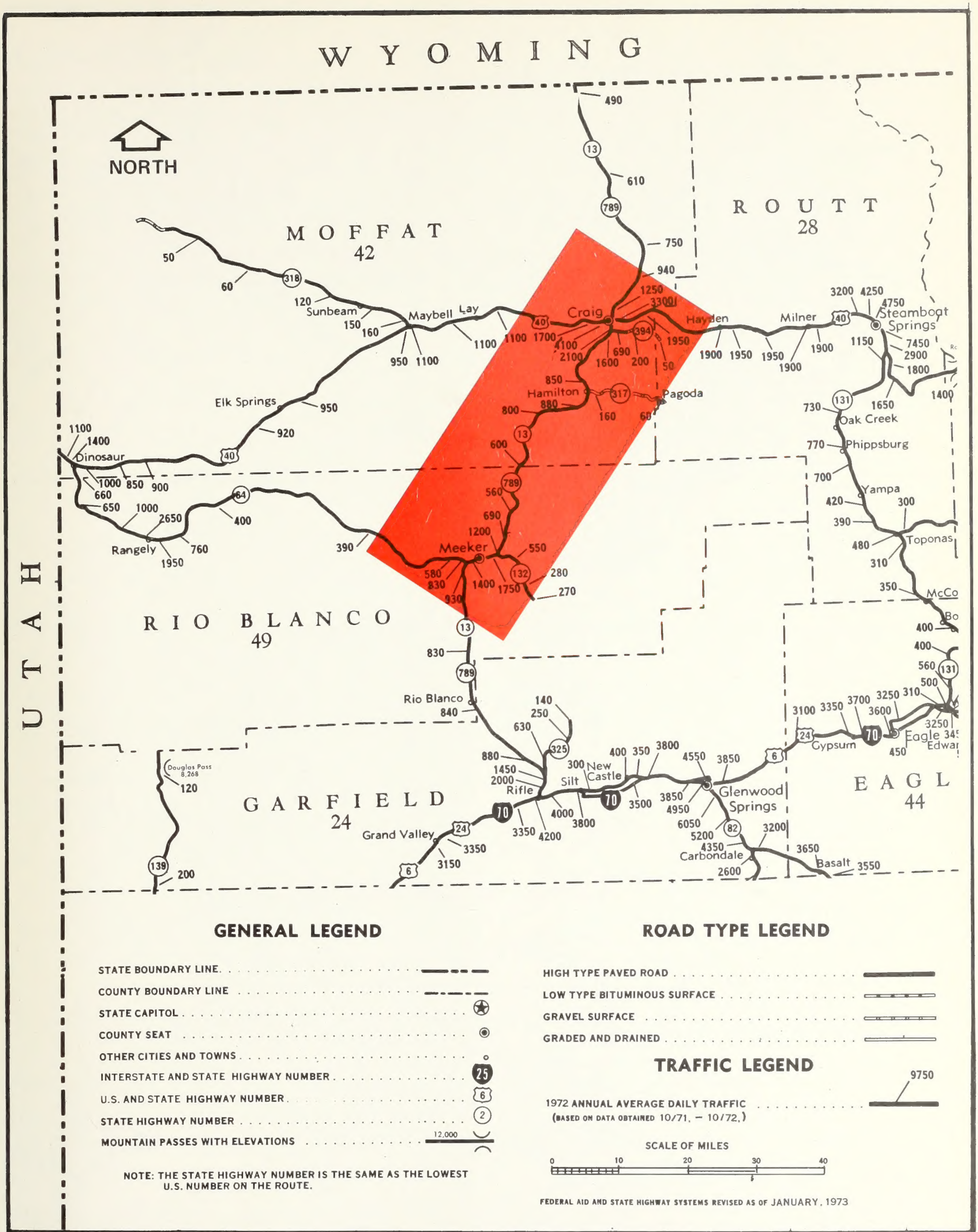
TABLE 27

TRAFFIC COUNTS OF REPRESENTATIVE SEASONAL MONTHS, 1973-74*

	Traffic Counts	
Season	**Month**	**No. Vehicles Per Day**
Summer	July	744
	August	786
Fall	September	662
	October	430
Winter	December	372
	January	315
	February	378

*Taken by State Traffic Counter No. 31 on Highway 13, 3 miles north of Craig

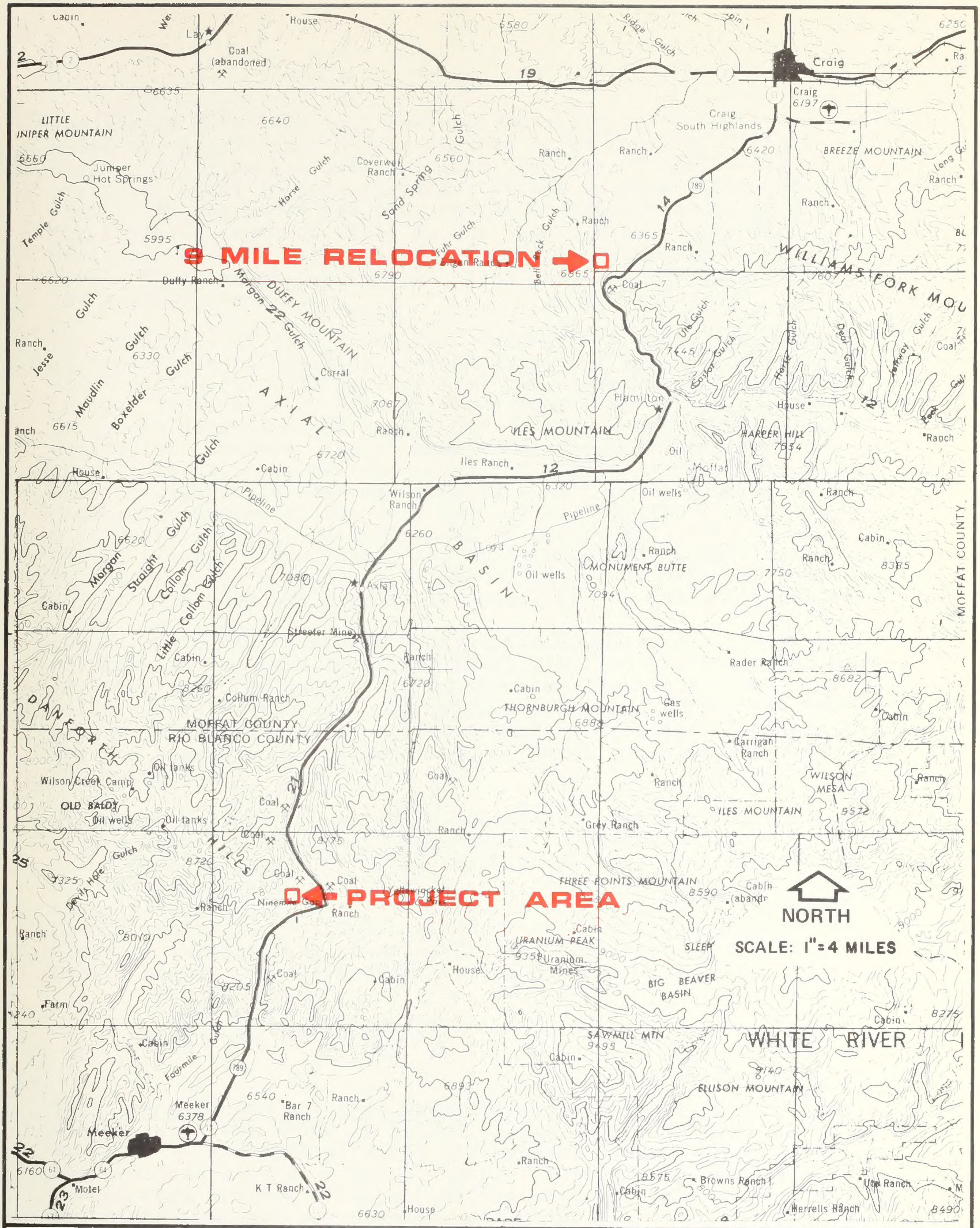
Source: Mr. Gene Goldsmith, State Department of Highways



1972 TRAFFIC VOLUMES
COLORADO STATE HIGHWAY SYSTEM

SOURCE: STATE DEPARTMENT OF HIGHWAYS

FIGURE 25



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LOCATION MAP OF COLORADO HIGHWAY 13

SOURCE: STATE OF COLORADO DEPT. OF HIGHWAYS

FIGURE 26

The Rienau Mine (American Fuels Corporation), located seven miles north of Meeker and thirty-two miles south of Craig on Highway 13, plans to begin hauling 600 tons of coal a day, averaging about 20 tons a truck starting in June 1974. At present it is not known how many trucks or trips will be made to the railhead south of Craig by the Rienau Mine. According to officials of both mines and Mr. Cummings, Maintenance Engineer of the Division of Highways in Grand Junction, no other mines are using Highway 13.

The condition of I-70 from Grand Junction to Rifle and Highway 13 from Rifle to Hamilton is generally poor and could present difficulties for coal haulage from the site to the railhead at Craig. It is narrow, with only two lanes, and large protions of it are in need of major repair due to snow damage, which is unavoidable. However, the highest traffic volume recorded on Highway 13 was 786 cars per day in August, 1973. A nine mile relocation of Highway 13 was completed late in 1973, beginning at Hamilton swinging to the west and connecting with U.S. 40 one mile west of Craig, as delineated on Figure 26. This portion of the highway is two lanes and is in excellent condition. The capacity of the highway is estimated to be 500 cars per hour, which means that the highway is operating far below its capacity.

According to Mr. Cummings, Maintenance Engineer for the Division of Highways in Grand Junction, there are five bridges on Highway 13 between Meeker and Craig, as shown on Figure 26. Only two bridges are restricted in any way, allowing a limit of 80,000 pounds for any combined vehicle. These two bridges are located between three to five miles south of Hamilton and are marked on Figure 26.

Steamboat Springs is served by scheduled commercial airlines (Rocky Mountain Airways). The Hayden Commercial Airport, 12 miles from Craig and 66 miles north of Meeker, is served by Frontier Airlines. Bus service into Meeker and Craig is provided by Wilderness Transit. Transportation facilities in Moffat County center in Craig with all main east-west and north-south highways intersecting there, and it is the location of the Denver and Rio Grande-Western railhead.

3. LAND USE AND ZONING

Existing Land Use and Land Ownership: Land ownership and land use by acres are shown in Tables 28 and 29. There are differences in acreages give for BLM managed land and Forest Service managed land depending upon source. This occurs because different sources utilize different definitions for determining land usage; the variations, however, are minor.

Moffat County has over one third of its entire acreage (37.5 percent) classified as privately owned rangeland, and approxi-

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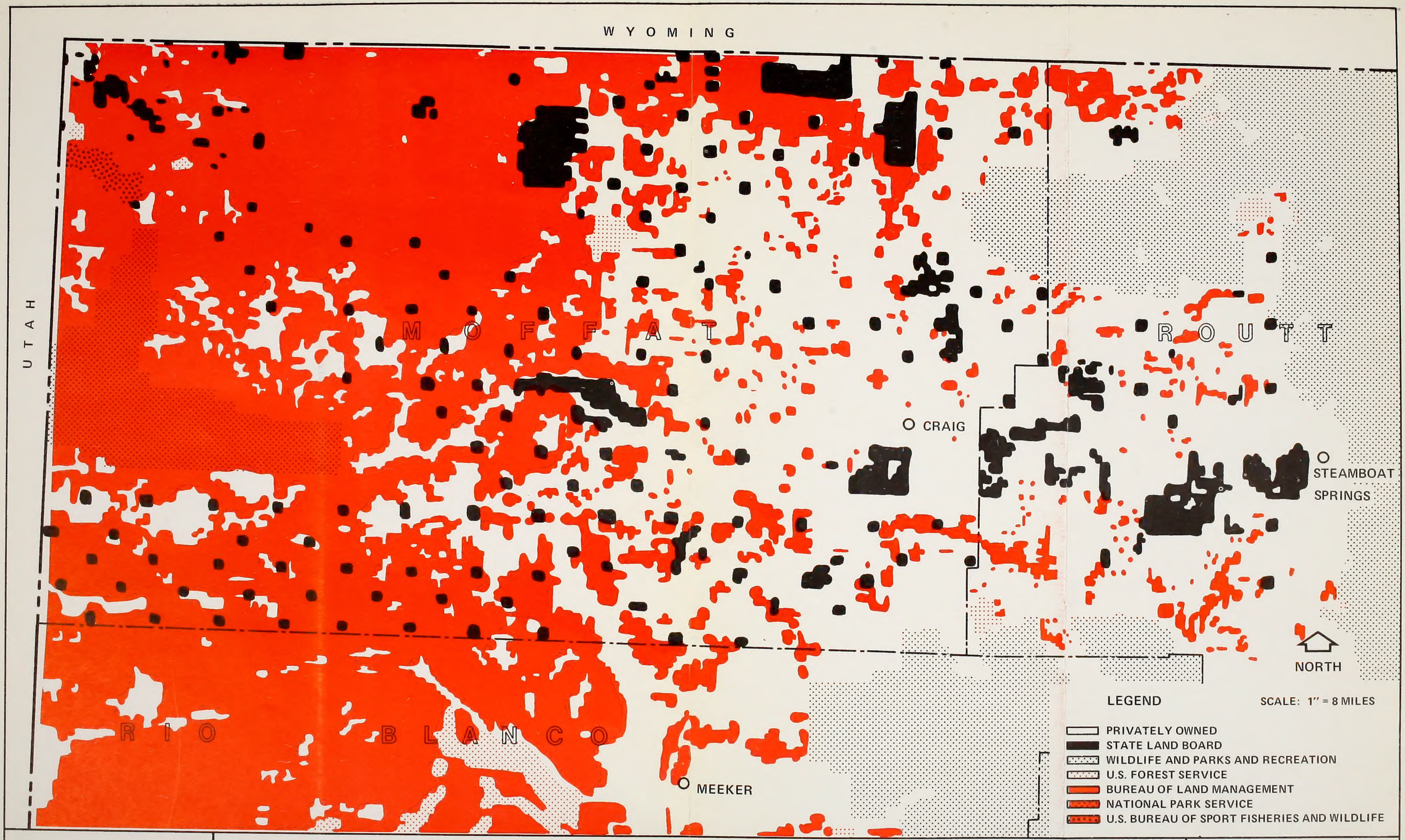

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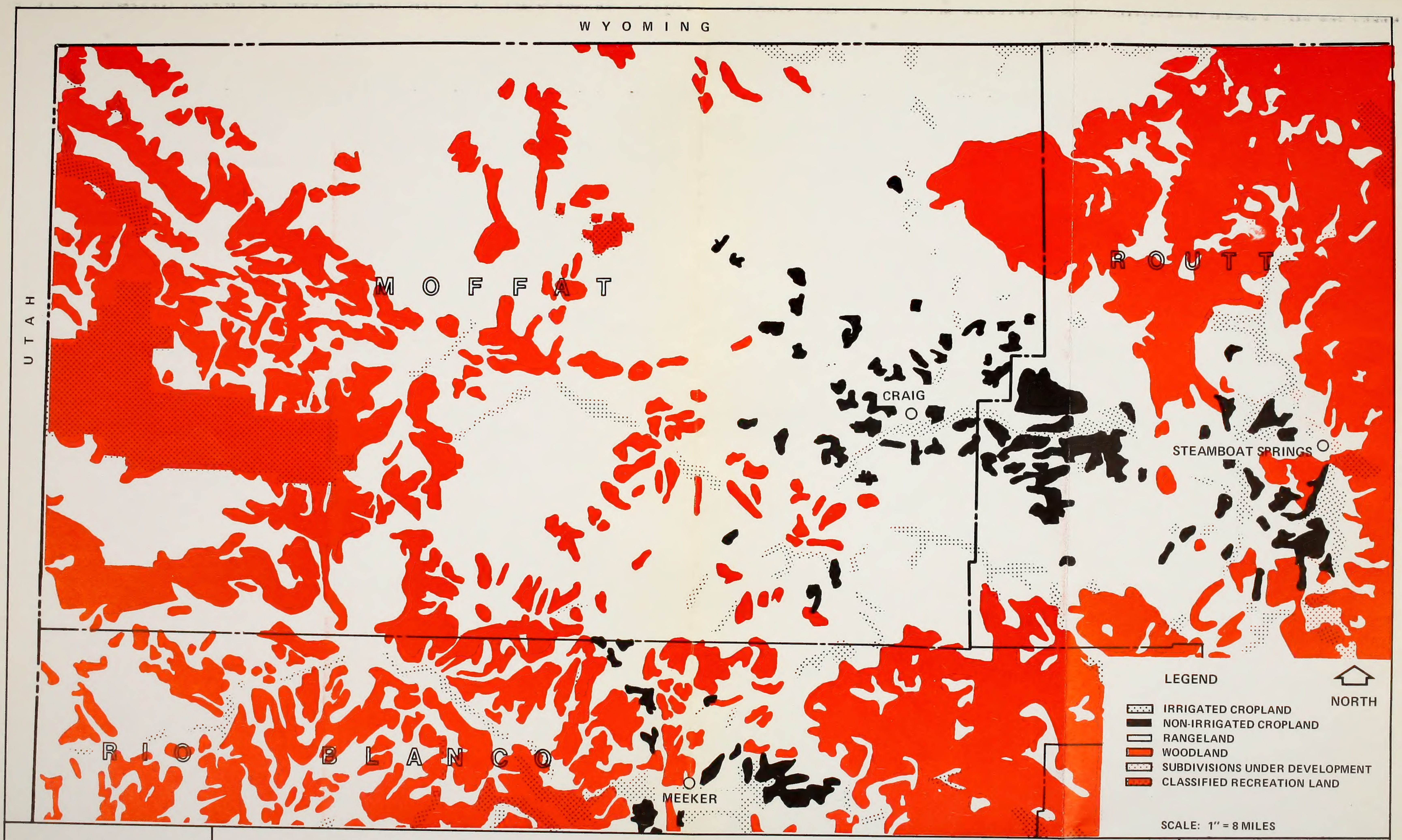
LAND OWNERSHIP
TRI-COUNTY REGION

SOURCE: COLORADO LAND USE COMMISSION

FIGURE 27



LAND USE
TRI-COUNTY REGION

SOURCE: COLORADO LAND USE COMMISSION

FIGURE 28

TABLE 28

LAND OWNERSHIP—LAND USE
TRI-COUNTY REGION
(In Acres)

Classification	**Moffat County**	**Routt County**	**Rio Blanco County**
Bureau of Land Management and Forest Service	1,540,394	1,542,240	1,550,029
Private, State and County	1,502,166	856,600	**
State, County and City	212,149	50,669 state only	**
Privately Owned	1,290,017	805,931	533,270
Rangeland	1,142,678	449,234	408,500
Irrigated Cropland	(Included in Irrigated Pasture)	1,000	32,500
Non-Irrigated Cropland	68,670	74,854	20,500
Irrigated Pasture	30,000	60,600	16,000
Non-Irrigated Pasture	28,087	4,900	7,000
Privately Owned Woodland	14,000	152,430	22,800
Commercial and Industrial	10,857	8,000	**
Residential and Subdivision	NA	15,100	4,418 urban & built-up
Other Classifications			
Recreation	NA	16,000	**
Wildlife		15,000	485,000
Transportation		2,013	
Water	2,175	**	1,575
Other	**	6,000	**
Total Land Area	3,042,560	1,485,520	2,088,320

**No land specifically labeled as such

NA - not available

Source: Soils Conservation Service—unpublished material.

TABLE 29

LAND AREA AND OWNERSHIP, 1970

	Total	BLM		Forest Service		Other State, County, Municipal and Private	
Area	Acres	Acres	Percent	Acres	Percent	Acres	Percent
Moffat County	3,035,520	1,516,363	50	41,763	1	1,477,394	49
Routt County	1,491,200	79,902	5	582,698	39	828,600	56
Rio Blanco County	2,088,320	1,189,460	57	358,661	17	540,199	26
Region	6,615,040	2,785,725	42	983,122	15	2,846,193	43
Colorado	66,327,040	8,465,124	13	14,361,432	22	43,500,484	66

Source: Bureau of Land Management

mately 50 percent as land managed by BLM (about 1,516,000 acres).

Routt County has less rangeland and more cropland than the other counties. Routt County also has more woodland; 39 percent of the total is managed by the U.S. Forest Service and five percent is managed by the BLM.

Rio Blanco County has large areas of sage and brushland in the central part of the county and woodland in the east. Small acreages of irrigated cropland between Meeker and Craig are indicated on Figure 27. Much of the land is Pinon-Juniper, sage and range grasses in the corridor area. The Colowyo mine land is almost entirely classified as "rangeland".

Only 42 percent of Moffat County's land is privately owned. At this time the recorded number of urban and subdivided acres is 2,960, according to the Colorado Land Use Planning Commission. This figure is very low in comparison to Routt County and Rio Blanco County figures. The urban and subdivided land acreage is growing fast in Moffat County as rising land prices indicate. Ownership patterns will change from agricultural to improved or developed usage if present trends continue.

Routt County has much land under subdivision development as Figure 28 indicates. Routt County depends upon tourist and recreational land use more than agricultural; thus the private sector ownership contains 15,100 acres of residential and subdivided land. Private land equals 54 percent which is the largest percentage of the three counties.

Rio Blanco County is similar to Moffat County in its land ownership patterns. Of the total land area, 0.2 percent represents urban and built up land, compared to Moffat County's 0.1 percent and Routt County's 1.1 percent. Privately owned land represents only 25.5 percent of the county's total acreage.

Land Use Controls: At present there are no state land use zones or plans in the area of the Colowyo Mine Company property. The Colorado West Area Council of Governments (CWACOG) is attempting to put planning on a regional scale. They have produced a report on oil-shale development with recommendations for future land use planning controls. Moffat and Rio Blanco Counties which are included in this CWACOG report, are developing their own revised zoning and long-range plans, both separately and as a part of the CWACOG. County planning will have significant impact on National Resource Lands, especially in relation to remote subdivisions, highways and waste disposal sites. Also included in the Oil Shale Report was an attitude survey regarding land use controls. The results indicated that there was citizen opposition to tighten land use controls; however citizen approval was given for continued improvement of present planning and zoning efforts. Plan-

ning priorities for the citizens and officials of Moffat County and Rio Blanco County include the development of a uniform building code and adoption of a city zoning plan. These should be in existence before the end of the year.

With the exception of land around Craig (and one strip of property between Meeker and the Mine site, Axial, which is zoned commercial property), most of the county is zoned agricultural. Two subdivisions have been bought by private firms near the City of Craig. The smaller of the two has had preliminary plans approved and a public hearing set for June 28, 1974. The larger subdivision will be heard in July although no preliminary plans have been approved, according to Don Gibbony, Planning Director.

The Elkhead reservoir nine miles northeast of Craig is zoned recreational, but unless the proposed Lower Yampa Project (Juniper Dam) is built, this recreational development is the only one presently planned. According to Duane Rehborg, Director of Rio Blanco Planning, mobile home parks are being used as "partial" solutions to the present growth. A new set of regulations has been passed which maintain or control high levels of modular housing with zoning codes and high fees. 108 acres next to Meeker have been annexed but not subdivided. As with Rangely in the west, peripheral growth brings with it transient construction people and mobile homes. Most growth will occur near existing towns as utility and service facilities become available. Planning for orderly growth is something the County Planning Commission in cooperation with CWACOG is attempting to accomplish through county and regional plans. Mobile home parks are being regulated by strict municipal codes and market values.

Moffat County, Rio Blanco County and CWACOG are applying for funding in order to develop county-wide Master Plans. A major portion of the good developable land near Meeker, several thousand acres, is being planned for development by Berry Brothers of Kansas City, but there has been no indication as to how soon preliminary development plans will be submitted.

Peripheral Growth-Existing New Town Plans: At this time there are no known plans for new town development in the region. THK and Associates suggested, in a recent study, expansion of present population centers, since none are crowded in terms of space. Peripheral growth should be limited to population centers because sprawling growth along transportation lines prohibits the provision of efficient urban services, and utilizes valuable irrigated agricultural land. Deliberate selection of growth areas will be possible as an adequate information base is formulated upon which decisions can be made.

4. REGIONAL ECONOMY

The major export sectors of products and services in the tri-county region are agriculture, mining, construction, utilities, and governmental services. Manufacturing and dairy related agricultural products account for the majority of all the import related leakages, income which goes out of the county due to imported products which is expected for a rural non-industrial area. Table 30 gives the total amount of income injected into the regional economy as a result of exports and the total amount of leakage of income resulting from imports. Earnings not generated or leaked by importing or exporting are generated by intra-regional transactions.

Agriculture: Ranching and farming remain major components of the economy with only a slight decline in acreage in farms, and the average farm size and the number of farms; see Appendix E for detailed information. Total cropland acres and irrigated cropland have shown increases in the 1964-69 period. One county whose total farm acreage did not decline is Moffat County; while the number of farms and the total amount of land in farms increased, the net result was a decrease in the average size farm.

Of the total principal products sold, 86.5 percent of the production came from the sale of livestock and their products, of which 59.2 percent resulted from cattle sales and 25.3 percent from sheep and hog sales. Moffat County leads in sheep and hog production with 42.7 percent of the regional total sheep and hog production. Crop production in order of importance in this area consists of hay, wheat, barley and oats. Hay accounts for 62 percent of the total agricultural production of the region.

Gross receipts for the tri-county region averaged $28,134 per farm while production expenses rose to an average of $24,332 per farm. It appears that the average cross-the-board return on investment was only slightly over $4,800. (Bureau of Land Management, 1974).

Of the three counties, Routt County is the leader in agricultural production with $9,921,000 in total agricultural cash receipts for 1969 and is a leader in beef production, $7,230,000 in cash receipts with hay being the principal field crop. Rio Blanco County was the least productive county in terms of agriculture having $5,600,000 net income from this source.

Mineral Extraction: Rio Blanco County ranked first of the three counties in petroleum and natural gas production as shown in Table 31. This county produces 49 percent of the State's total

TABLE 30

REGION
EARNINGS BY MAJOR INDUSTRIAL SECTOR, 1970

Industry	Earnings ($1,000)	Export Related Earnings ($1,000)	Import Related Earnings ($1,000)
Agriculture			
Livestock (Ex. Dairy-Poultry)	$ 8,621	$ 7,003	
Other Agriculture	2,319		$ 1,733
Mining			
Metal	$ 343	$ 304	
Fossil Fuels	7,962	7,363	
Quarrying	483	410	
Contract Construction	$ 4,483	$ 946	
Manufacturing			
Food and Kindred Products	$ 65		$ 2,014
Lumber and Wood Products	614	$ 249	
Other Manufacturing	564		9,433
Transportation and Communication	$ 1,601		$ 772
Public Utilities	$ 2,085	$ 917	
Wholesale & Retail Trade	$ 6,782		$ 617
Finance, Ins. & Real Estate	$ 966		
Services	$ 6,371	$ 1,732	
Recreation*			
Government			
Federal	$ 2,706	$ 2,706	
State & Local	6,186		
Region Summary	$52,151	$21,630	$15,334

*Data is not available.
Source: Bureau of Land Management

TABLE 31

VALUE OF MINERAL PRODUCTION IN DOLLARS 1970-1972

Mineral Sector	Moffat County	Rio Blanco County	Routt County	Tri-County Region	Colorado
Total All Minerals					
1970	$10,074,610	$43,365,087	$11,626,900	$65,066,597	$371,883,497
1972	10,212,907	60,370,833	13,932,842	84,516,582	406,297,848
Sand and Gravel					
1970	408,354	106,034	2,750	517,138	26,714,822
1972	880,572	NA	83,720*	964,292	36,966,358
Volcanic Scoria					
1970	NA	NA	35,861	35,861	251,217
1972	NA	NA	*	NA	322,000
Petroleum					
1970	3,572,924	39,099,088	241,809	42,913,821	80,060,687
1972	3,232,279	56,003,071	239,465	59,474,815	113,653,630
Gas					
1970	3,422,950	4,140,847	430	7,564,227	16,933,910
1972	4,295,231	4,339,970	38	8,635,239	21,411,081
Coal					
1970	2,670,382	19,118	11,346,050	14,035,550	34,320,056
1972	1,804,825	27,792	13,609,619	15,442,236	33,734,093

*Figures combined in 1972

Source: A Summary of Mineral Industry Activities in Colorado 1970-1972; Colorado Bureau of Mines

petroleum production and 20 percent of the natural gas production. In 1972, the total value of mineral production in this county amounted to $60,370,833, approximately six times that of Moffat County, and farmland one-half times that of Routt County as given in Table 31.

The total volume of mineral production in Routt County for 1972 was approximately $14,000,000. Coal mining was the major mineral producer in the county with current coal extraction rates averaging two million short tons of coal per year.

Until recently, Moffat County contributed the least of the three counties in terms of mineral production. However, with the new Colorado-Ute Power Plant and other projected coal-related mineral resource developments, Moffat County will shortly exceed the regions total coal production of 2,531,527 short tons a year. The proposed Colowyo Mine alone projects 3,000,000 tons a year by 1980; Table 32.

TABLE 32

PRODUCTION OF OIL, GAS AND COAL TRI-COUNTY REGION 1970-1972

	Moffat County	Rio Blanco County	Routt County	Tri-County Region	Colorado
OIL (Bbls)					
1970	1,149,275	11,540,177	78,213	12,767,665	24,723,337
1972	910,501	15,775,313	67,455	16,753,469	32,015,107
Federal Leases 1972	596,678	9,850,652	21,389	10,468,719	10,980,932
GAS (MCF)					
1970	23,519,656	21,610,037	2,717	45,132,410	118,431,882
1972	25,266,064	25,529,238	266	50,795,528	125,992,570
Federal Leases 1972	16,647,153	21,279,015	0	38,026,168	45,565,384
COAL (Short Tons)					
1970	468,488	1,990,535	3,354	2,462,377	6,021,062
1972	295,873	2,231,085	4,659	2,531,527	5,530,179
Federal Leases 1972	93,292	1,195,531	4,659	1,293,292	1,769,953

Source: Colorado Oil and Gas Statistics and Colorado Coal Statistics, Federal Lease Information From U.S. Geological Survey Reports.

Recreation: The tri-county region is oriented toward recreational use that is classified as "national and regional outdoor recreational use." Major attractions include ski areas near Steamboat Springs and big game hunting for deer, elk, and antelope which is found in all three counties. Both provide support for wholesale and retail trade and for the services sectors of the tri-county region. In the 1971-1972 season, over one million dollars was spent in the tri-county region, namely Routt County, on lift tickets alone. It is estimated that at least $600,000 was injected into the economy in the Steamboat Ski Area in 1971-1972. Hunting contributed an estimated $505,400 in direct income based upon an average $10 a day expenditure per total hunter day use which, for 1972, was 60,639 total hunter days (17,526 hunters).

Regional Tax Profile: A major proportion of taxes collected for county use are property taxes. In 1973, approximately $1,494,816 in total land taxes were collected in Moffat County. Table 33 below shows levies assessed by type. In Moffat County as in all Colorado counties, a tax levy based upon mills, ($.001), is collected for each district based upon real and personal property valuation.

TABLE 33

MOFFAT COUNTY TAX LEVIES
1973

Type of Levy	Levy Mills
School District	43.63
Cities (Municipal Levy)*	19.00
County Levy	21.79
Average Special District (local improvement and service) Levy*	1.87
Total Average Levy—City Limits	**86.29**
Total Average Levy—County	**65.82**

*Not collected outside city limits.

Source: Division of Property Taxation, 3rd Annual Report, *1974, p. 171.*

For tax purposes, property is assessed at 33 percent of its real value. For instance, land valued at $30,000 would be taxed at .33 x $30,000 x $.06582 or $658.20 if county land and .33 x $30,000 x .08629 or $86.91 if within the city limits of Craig.

TABLE 34

MOFFAT COUNTY ASSESSMENTS
NATURAL RESOURCE LAND - REAL ESTATE & IMPROVEMENTS

	Acres		Per Acre Value		Valuation	
	1972	1973	1972	1973	1972	1973
Producing Coal Land	68	31	$500.00	$1,040.00	$ 34,000	$ 32,240
Non-Producing Coal Land	102	102	250.00	520.00	25,500	53,040
Undeveloped Coal Land	200	172	50.00	100.00	10,160	17,320
Developed Coal Land	61	119	125.00	260.00	7,620	30,940
Coal Land Improvements					36,550	36,550
Mining Non-Producing	36,270	28,775	.90	1.05	32,600	30,290
Mining Improvements					100	100
Producing Gravel Land	78	61	110.00	145.00	8,600	8,790
Non-Producing Gravel	81	80	9.88	9.50	800	760
Gravel Land Improvements					520	530
Oil & Gas Production					5,017,900	5,145,580
Oil & Gas Improvements					767,110	799,050
Coal Reserves	3,250	19,040	1.00	1.00	3,250	19,040
Mineral Reserves	432,024	443,928	1.45	1.45	629,760	645,260
Totals					**$6,574,470**	**$6,819,490**

Source: "Abstract of Assessment," 1972 and 1973 for Moffat County, Colorado

Table 34 shows the assessed value of natural resource land within Moffat County.

The $6,819,490 figure represents nearly 35 percent of the county's total real estate with improvements which is $19,255,240. It also represents approximately 30 percent of the total assessment of real and personal property, which is $25,722,450. The total taxes collected, $448,858, represent approximately 23 percent of the county's total tax revenue collected. Other county revenues come from other government, federal and state, licenses, permits, fees and fines.

4. ARCHAEOLOGY, PALEONTOLOGY, AND HISTORY

Archaeology

On May 27, 1974, Dr. D. A. Breternitz and two doctoral candidates from the University of Colorado conducted a preliminary archaeological assessment of the project site. Very little evidence of archaeological remains was found. It is felt that six man days of further surveys on the project site would be adequate to complete a thorough archaeological study. This survey will be conducted this summer. Dr. Breternitz's report is in Appendix C.

Paleontology

The Williams Fork Formation was formed in a marine deltaic environment similar to the Mississippi Delta during the late Cretaceous period (approximately 73 million years ago) at the onset of the Laramide orogeny (thrusting upward of the mountains) which formed the Rocky Mountains.

The coal seams in the formations are the result of accumulated plants in a deltaic marsh. Many fossil plant imprints may be found in the coal. Both terrestrial fossils washed in by rivers, and terrestrial animals (fossils) which lived around the marsh may be found in these formations as well as shallow-bay marine sharks and shellfish.

Very little is known about the fossil potential of these formations because they have never been thoroughly researched. Studies in the past have yielded several plant and invertebrate fossils (shellfish) from marine, estuarine, and swampland environments. Preliminary investigation of the Colowyo Mine revealed no fossils; however, a detailed surface survey for paleontological resources will be conducted in conjunction with

the archaeological walk-through of the site.

Regional History

Prior to frontier settlement, the region was occupied by the Ute Indians. Trappers such as Jim Baker, Jim Bridger, and Joe Meeker were the first settlers to come into the area in the 1830's. The Indians in the area were very friendly to the early settlers, which encouraged the arrival of more and more settlers.

The cattle industry began to spring up in the 1850's when ranchers from Texas began driving their cattle through the area enroute to market and the California gold fields. In 1879, the settlers desire for more land, and a series of misunderstandings led to an Indian uprising which brought about the Thornburg Ambush and the Meeker Massacre. Following these events, the Ute Indians were relocated to reservations in southern Colorado and eastern Utah, which allowed settlers to acquire more property.

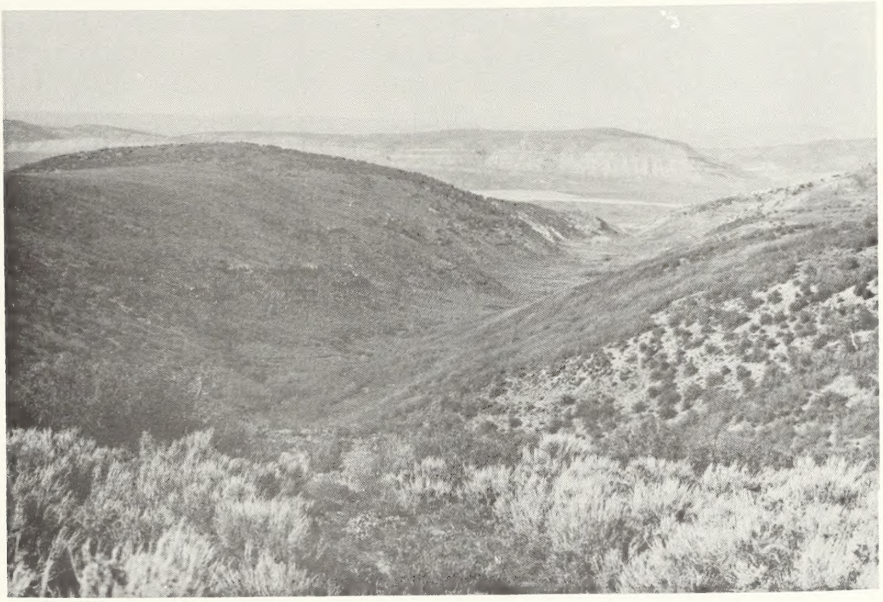
In the early 1900's, the railroad came to Craig from Denver. Craig was incorporated in 1908 and was entirely dependent upon the cattle industry. The area at this time was roamed by Butch Cassidy and the Sundance Kid and their gang, the "Wild Bunch".

The cattle industry declined during the first half of the 20th century. Oil was discovered in the region in 1924. The mining of coal also began in the region during this period. During World War II, the Texas Oil Company built a refinery in Craig which was a major oil supply center. The refinery was closed in 1948 and moved to Casper, Wyoming. Coal mining then became an important industry and is growing today. Tourism also gained in importance. Today timber, wheat production and trucking contribute to the economy of Craig.

6. AESTHETICS

The aesthetic qualities of an area may be defined as perceptual aspects which, although difficult to quantify, may be assigned positive or negative value. Certain qualities such as air and water quality, scenic features and open space are recognized as having aesthetic value although these values are largely a matter of individual preference. A series of photographs can best illustrate the aesthetic values of the area. The project site and the surrounding area represent a typical semi-arid landscape with no unusual landforms. Although the area is aesthetically pleasing, it is unlikely that it would be officially designated as a scenic or recreational area. The region contains areas such as the White River National Forest and Routt National Forest, so that by comparison the project site area does not have a high aesthetic rating.

The following section is a visual and verbal description of the landforms and topography of the Colowyo Mine site:



Located on the south flank of the Axial Basin Uplift, the property is typified by gently sloping northerly mesas with surface elevations ranging from 7,000 to 7,600 feet above sea level. The mesas are cut by streams forming deep canyons and hogback ridges, particularly along Taylor and Good Springs Creeks. The landscape is subdued in colouring, charactrized by soft buff greens and browns blending into the blue-grey of distant hills.

The area is marked by a wide variety of vegetation of the kind that is indigenous to a semi-arid region, with rolling hills covered with sagebrush and sparse bluegrass. North slopes abound in scattered oakbrush, juniper, and serviceberry with an occasional stand of aspen.

Populus tremuloides (QUAKING ASPENS)

Flatter areas of the property provide a contrast to the rolling hills. The remnants of past uses of the area are still evident in the presence of the old mine site and the remains of an old homestead.

THE BILL GRAY HOMESTEAD - BUILT AROUND 1918

ENVIRONMENTAL IMPACTS OF THE PROPOSED PROJECT

V. ENVIRONMENTAL IMPACTS OF THE PROPOSED PROJECT

A. THE PHYSICAL ENVIRONMENT

1. PHYSIOGRAPHY AND LANDFORMS

A direct adverse impact will result from the change in site physiography by (1) sequentially altering and/or eliminating existing landforms on approximately 1,930 acres to be surface mined or dedicated to ancillary facilities, and (2) lowering the existing ground surface in areas where coal is extracted. Surface mining on the site may alter or destroy the prominent steep bluffs along Taylor and Good Spring Creeks and the steep side of the tributary to Good Spring Creek that flows by the Colowyo mine, as well as less prominent features such as depressions and small ridges on the mesa surfaces, drainage patterns, and moderate slopes. Many of these features are presently visible from State Highway 13 which passes along the easterly boundary of the site area; however, no surface mining activities will be visible from either Highway 13 or from Moffat County Highway 51.

Elevation (topographic) changes associated with coal bed removal will not be equivalent to the thickness of coal removed if all "overburden" is replaced. Depending upon the volume increase of the overburden when it is broken up and degree of compaction when it is replaced, the land surface will probably be lowered less than the total coal seam thickness removed.

Additional direct impacts on the physiography will be created by grading of associated mine access or haul roads and/or other transportation corridors across areas other than the proposed mine location.

Alteration of drainage courses may have an indirect adverse effect on localized areas in relation to pattern and amount of runoff available and its contribution to surface (e.g., stock ponds) and subsurface water accumulations. There will be an increased potential for erosion during construction and during the initial phases of reclamation.

Beneficial direct and indirect impacts from altering the topography may be: removal of topographic irregularities leaving areas of relatively flat land which are better for cultivation, irrigation, grazing, and future land development; alteration of drainage courses to (1) retain more surface water at the site for irrigation, wildlife and stock watering, and increased percolation potential; and (2) reduction of runoff to surrounding streams, thus decreasing the flooding and erosion potential

downstream of the site; and removal of steep bluffs to make access to the surrounding mesas easier for hunting, wildlife, migration, grazing, and cultivation purposes.

2. GEOLOGY

Stratigraphy

The principle direct adverse impact on the stratigraphy will be the destruction of the local stratigraphic section represented by the rocks of the Williams Fork Formation. This will include disturbance of the overburden, existing or potential aquifers, and the removal of irreplaceable coal seams.

Depending on the physical characteristics of earth materials and the slope orientation of mine face cuts around the strip mining pit, slope stability problems may be created due to exposing potentially unstable rock or soil units. The stratigraphic units containing a significant quantities of clay may expand and contract during alternating periods of wet and dry conditions and create unstable conditions (i.e., sloughing, rockfalls, etc.).

Indirect adverse effects related to removal or alteration of the stratigraphy are the possibility of slope failures (landslides, slumps, or excessive erosion) resulting on mine pit slopes that may propagate into areas adjacent to the mine and reduce their stability.

Beneficial indirect impacts are: 1) once excavation of the uppermost coal seams has been completed, underlying seams that were earlier too deep to be surface mined economically will be more accesible; 2) excavation on the site will provide exposures for obtaining information about the stratigraphy that would not otherwise be available. The mining operation may provide information relating to more efficient methods of overburden removal and replacement in similar areas.

3. SOILS

Direct adverse impacts on the soils due to the mining activity would in part be equivalent to the impacts on the physiographic environment because the soils also contribute to the appearance of the land surface by supporting vegetation. Excavating and stockpiling soils will affect their quantity, quality, and nutrient content. Soil could be lost due to incomplete removal for stockpiling or during transportation to stockpiling or eroded off of the

stockpiles. The soil's physical properties could be changed by dilution and disturbance of soils during excavation and stockpiling. Changes in natural moisture conditions may produce chemical changes that decrease or increase soil quality. Without immediate revegetation, nutrient supply would decrease while the soil is stockpiled; and, in fact, water percolating through the stockpile could probably remove nutrients possibly resulting in a net loss.

In the absence of good engineering practice, the surrounding drainages could be adversely affected by the increased sediment content of the runoff from areas of disturbed and unstabilized soil.

Removal of the soils negates the possibility of studying these materials in place should this be desired. A visual inhomogeneity (e.g., color, textural change) could be created upon replacement of the soils after mining. However, there are no known unusual or unique soil types in the mine area and the reclamation program should return the land to a state not inconsistent with this agricultural area.

Beneficial impacts of removal, stockpiling, and replacing the soil could include an improvement of the engineering and geologic properties (e.g., permeability, shrink-swell potential, and other foundation characteristics) of the in-situ materials resulting in a higher net productivity per acre on the reclaimed mine area.

Soils underlying the organic zone may contain nutrients both leached from above and occurring naturally. When mixed with the leached soils, these soils may be at least as capable, and possibly more capable, of supporting vegetation than the original surface soils.

4. GROUNDWATER

Direct adverse impacts to groundwater are related to the removal and destruction of the shallow discontinuous aquifers which are positioned above the mineable coal seams. Destruction of these aquifers would eliminate some of the springs which feed Taylor Creek and Street Creek. The principal aquifers which are located in the stream alluvium of Good Springs Creek and Wilson Creek would not be affected by the proposed mining operation.

Secondary effects of the destruction of the shallow aquifer system would be reflected in decreased surface runoff during the summer and fall months. A decrease in surface runoff would decrease the amount of surface recharge to the principal

alluvial aquifers underlying Wilson and Good Springs Creeks.

Possible beneficial effects of excavation on the site may be to allow water to infiltrate into deeper aquifers that are at least equivalent or better than those affected by mining operations, thus restoring or improving the immediate groundwater resources. Groundwater exploration would yield data useful to understanding the related systems in this portion of the basin and to aid in developing management approaches for future use and conservation of the goundwater resources.

5. SEISMICITY

The proposed project will have no adverse or beneficial effects on the local or regional seismicity. However, due to the moderate seismicity of the Rangely and Steamboat Springs areas which are within approximately 54 miles of the site, the effect of seismicity on stability of slopes should be considered. This may offer the opportunities to study the concepts of pit slope stability in a moderately active seismic environment.

6. SURFACE WATER

Current mining plans call for the initial box cuts to be located in the Taylor Creek valley. Mining activities will begin near the property boundaries and proceed up the valley until the basic outlines of the mining plan are fulfilled. In order to assess how this type of mining plan will affect the water resources of the Taylor Creek-Wilson Creek drainage system, potential impacts must be gauged in accordance with three types of criteria. These are:

1) Effects of landform alteration on drainage patterns and streamflow

2) Effects of mine induced water usage and impoundments upon streamflow

3) Effects upon water quality

Effects of Landform Alteration on Drainage Patterns and Streamflow

In order to maximize mining efficiency for total property development, it could prove necessary to redirect the flow of Taylor Creek away from mining operations. In that Taylor Creek

occupies the base of an extremely narrow valley which features gradients of slope in excess of 40° it is possible that the relocation of these waters would have to be in the Wilson Creek drainage system upstream from the mine property. This would involve collecting the water and pumping it over the boundary lines separating the respective drainage basins prior to discharge into Wilson Creek. Water could then be returned at a point below the mine if needed to satisfy downstream water appropriators.

Colorado has no existing laws which would prohibit a diversion of this type assuming such actions did not impair a downstream user's rights. This is particularly true in those instances, as in Taylor Creek, where the stream is incapable of supporting a viable fishery. In Colorado, unlike other nearby states, these decisions are made in the judicial arena with important inputs being offered by various concerned agencies.

It also is possible that mining activities could proceed without such a drastic relocation of the traditional flow pattern of Taylor Creek waters. In this case the stream system could be contained within culverts throughout the area undergoing active mining operations.

Effects of Mine Induced Water Usage and Impoundments upon Streamflow

Any additional effects upon streamflow resulting from the proposed development will be dependent upon the system of impoundments and berms necessary to localize surface and groundwaters in areas adjacent to actual mining operations.

On-site water usage will not constitute a significant impact on these water systems in that the coal mined at this site will not require large volumes of water. Only minimal amounts of water will be used for maintenance of haulage roads, dust control and possibly for water supply and sanitary purposes.

Effects upon Water Quality

The potential impacts to downstream water quality would be predicated upon the occurrence, concentration and ultimate release of various toxic trace elements, and radioactive isotopes. Increases in total dissolved salts and suspended solids can also result when stripped spoil banks are exposed to the various forces of erosion and contribute leachates to the receiving drainage. In addition, the unlikely possibility of acid mine drainage formation must be quantified. Each of these potential

problem areas is discussed in more detail in the following paragraphs.

Trace elements and various isotopic materials are present throughout most soil types. Removal of soils and overburden materials serves to expose these deposits to leaching by a combination of surface runoff and fluctuating groundwater tables. Prior to mining, a substantially smaller percentage of these materials are subjected to these hydrologic forces. Surface mining activity can result in increasing the concentrations of the elements in receiving streams, thus serving to increase the potential health hazards associated with animal and human consumption of the affected water supply. Among the trace elements currently receiving the closest attention from public agencies are: Mercury, Cadmium, Chromium, Vanadium, Lead, Titanium, Cobalt, Molybdenum, Copper, Nickel and Manganese.

Total salinity in a receiving drainage system can increase due to mining activities in a variety of ways. All of these, however, are indicators of the amount of erosion and leaching actively occurring in the overburden stockpile areas. Total salinity resulting from surface mined lands follows closely the basic nature of the soil types and the effects of wind, runoff and chemical erosion and can result from exposing large blocks of land to these physical forces without the protection of surface vegetation and berms.

The third area of concern in attempting to assess water quality impacts previous to a coal mining development is in evaluating the potential for acid mine drainage formation. While this has posed serious problems in eastern deep coal mining operations, it has presented no problem in surface or deep mining operations of Colorado, Wyoming and Utah. It has been shown in a study involving western coal deposits that the potential for acidic discharge is directly related to 1) the amount of reduced substrate available for oxidation and 2) the amount of buffering capacity available in the receiving waters to neutralize the incoming acidity (McTernan, 1974). Low sulfur coal deposits are generally contributive of such low volumes of potentially oxidizable substrates that no overt signs of acidity formation are ever detected. The minute amounts of acid produced are readily neutralized by alkalinities in the receiving waters without adversely diminishing the stream's capacity to buffer itself.

Erosion and Sediment Increases: The impact on the surface mined land forms of mining operations will be mirrored in terms of total erosion on the lands and ultimate sedimentation in the water courses affected by mining operations. Erosion along spoil areas is measured by periodic surveys while sedimentation

in receiving streams is monitored from analyses of grab samples taken at representative periods throughout the year.

7. CLIMATE

Alteration of the topography and removal of vegetation will slightly interfere with the micro-climate of the project site. Wind, humidity and heat disbursement patterns will be slightly modified by the surface mining operations. While the impacts of this project on the over-all climate of the region will be negligible, the cumulative effects of several such projects could have a proportionately greater effect on the local climate. Revegetation of the project will have a mitigating effect by returning the relative humidity and heat disbursement patterns to a more natural state.

8. AIR QUALITY

Emission Sources and Estimation Methodology

Major potential atmospheric pollutant emissions ascribed to the mining operations are as follows:

1) Fugitive dusts and diesel exhaust emissions from equipment used in the removal and disposal of overburden and the extraction of surface coal;

2) Particulates emitted from such coal processing operations as conveyor transport and size reduction;

3) Particulates and gaseous emissions from truck and railroad transport facilities;

4) Ultimate emissions caused by the combustion of the coal at its final destination.

5) Indirect source emissions contributed by motor vehicle population increase.

The pollutants associated with the total of these sources are particulates, carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NO_x) and sulfur oxides (SO_x). The methodology applied in this report for the determination of gross emission values, expressed in tons/year of pollutant, is as follows:

1) Modified fugitive dust emission factors (Development of Emission Factors for Fugitive Dust-Sources and Control, 1974) will be applied to overburden and coal removal rates to obtain total particulate emissions.

2) Estimates of earth-moving diesel tractor operations will be made and established factors (Compilation of Pollutant Emission Factors, 1973) applied to yield particulates and gaseous emissions.

3) Coal production rates will be converted into diesel truck mileage values and emission factors applied (Compilation of Pollutant Emission Factors, 1973).

4) Based on an estimates fuel analysis, the pollutant-emission potential of the coal, as utilized at its final destination, will be determined.

5) Indirect source emissions is defined as "any facility that attracts or is assoicated with secondary activity which may emit any air pollutant for which there is an ambient air standard." Thus, any significant increase in mobile source activity caused by the mine's operating personnel will be evaluated.

Pollutant Gross Emissions

Overburden Removal and Coal Mining Emissions: In the reference cited, "Development of Emission Factors for Fugitive Dust Sources," emissions have been estimated for fugitive dust discharges from construction operations, tailings piles, and aggregate storage; see Table 35. Although none of the sources are directly concerned with surface mining, approximate adjusted emission factors were determined and order-of-magnitude dust loads calculated.

Fugitive dust emissions from area strip mining operations are a function of the amount of soil acreage disturbed and the overburden removal and retrieval systems.

Process values for the proposed mining operations have been determined in the Air Resources Calculations, Appendix G. Coal is to be extracted from a series of strips, each measuring 120 feet wide by 5,000 feet long. At a seam depth of 13 feet and a coal density of 80 lb/ft^3, the coal mined per strip would be 312,000 tons. At a coal production rate of 600,000 ton/yr during the first three years, comprising Phase One, approximately two (5,000 ft. x 120 ft.) strips would be excavated each year. During Phase Two operations, for years 4 through 16, ten strips per year would be mined. The equivalent acreage disturbance rate would be 27 acres/yr. during Phase One and 135 acres/yr. during Phase Two.

The overburden quantities, based on a ratio of 5.1 yd^3 overburden per ton of coal, would be 5.4 x 10^6 ton/year and 27 x 10^6 ton/year removal rates for Phase One and Two, respectively. The average overburden depth is calculated to be 70 feet. Actually, it varies from 20 feet for the initial cuts to 140 feet towards the end of the mine's life.

The mining prodedures are comprised of the following major operations:

1. Topsoil removal to be accomplished with self-loading scrapers and bulldozers and trucked to holding areas. The greatest intensity of dust emissions for this operation occurs during the loading and unloading of the transport trucks.

A breakdown of the various sources contributing to an overall emissions factor for aggregates handling is shown in Table 35. An adjusted value of 0.10 lb/ton will be arbitrarily chosen for the current problem, based on estimated soil-type differences.

2. Overburden, less about 12 inches topsoil, is removed from the top of the coal seam by dragline, following blasting. This material is loaded and discharged by the dragline, being transferred to the space produced from the preceding cut. The major emissions are those produced by the overburden piles, as they are formed by the dragline discharge and the subsequent losses by wind erosion.

A composite emissions factor of 0.07 lb/ton of overburden will be applied, based on the data reported in Table 35. Blasting emissions data are unavailable and this potential air pollution source has not been quantified.

3. The overburden piles will be re-contoured in place in preparation for replacement of the topsoil. The bulldozer and scraper activities required will cause some dust emissions.

Based on C. H. Cowherd Jr. (1974), an emissions factor of 40 lb/acre will be applied.

4. Topsoil from the hold areas will be transported and distributed in the mined area and then contoured to suit. The major emissions will be assumed to be similar to those in Operation 1 and a value of 0.10 lb/ton of topsoil will be applied.

Based on these mining and reclamation procedures and applying the various emission factors to the calculated materials-moving rates, fugitive dust discharges to the atmosphere have been estimated, as shown in Table 36. These values have been determined for Phase One and Phase Two. Thus for the 600,000 ton/year

TABLE 35

AGGREGATE STORAGE EMISSIONS BREAKDOWN

Source Activity	Correction Parameter	Emission Factor lb/ton
Pile Formation	Activity index	0.43
Vehicular Traffic	Rainfall frequency	0.13
Wind Erosion	Climatic factor	0.11
Load out from Piles	Activity index	0.05
		0.33

Source: Adapted from C.H. Cowherd Jr., "Development of Emission Factors for Fugitive Dust Sources," Midwest Research Institute, Kansas City, Missouri, June 1974.

TABLE 36

ESTIMATED UNCONTROLLED FUGITIVE DUST EMISSIONS FROM STRIP MINING OPERATIONS

(All values expressed as ton/year)

Phase	Coal Production	Dust Emissions From Operations No.				Total
		1	2	3	4	
1	600,000	3.3	189	0.5	3.3	196.1
2		16.5	945	2.5	16.5	980.5

coal production rate the fugitive dust emissions for Operation One, Two, Three and Four have been added on the assumption that they will proceed concurrently, for a total discharge rate of 196.1 ton/year of dust. The total fugitive dust emissions rate has been similarly estimated for Phase Two at 980.5 ton/year.

The estimation of fugitive dust emissions is based on very preliminary empirical data. Obviously, the factors to be applied for the various mining operations are influenced by soil type, moisture and prevailing winds. The result expressed in Table 36 can be considered as order-of-magnitude estimates.

Actually the uncontrolled emission values in Table 36 underscore the need for mitigative measures. Such measures mainly comprise thorough and continuous wetting of the mining area. This practice is normally considered mandatory in surface mining operations, and when followed, should reduce fugitive dust emissions for this phase of the operation to negligible levels.

In addition to particulate emissions contributed by fugitive dust, particulate and such gaseous emissions as CO, HC, NO_x, and SO_x. from the various diesel-powered mining machiner must be determined. However, information concerning operating schedules, specific mining rates and modes, and the machine power ratings must be obtained as prerequisite for these emission estimates. In Table 37 , there are shown pollutant emission factors for heavy-duty diesel trucks which may be applied to operating schedules and power rating data to obtain total emissions.

TABLE 37

POLLUTANT EMISSION FACTORS FOR DIESEL TRUCKS

Pollutant	Emissions, g/mi.
Particulates	1.2
CO	20.4
HC	3.4
NO_x	34.0
SO_x	2.4

Source: EPA; "Compilation of Pollutant Emission Factors"—EPA Publication AP.42, April 1973.

Process Emissions: The process particulates emissions to be considered are those being discharged by the coal crushers and various transport conveyors at the lookout station. In Phase I there is a single primary and single secondary crusher, in series, each hav-

ing a capacity of 650 tons/hr. In phase 2 there are four crushers in a series-parallel arrangement, each with a 650 tons/hr. capacity. For this service, it is estimated that each hammermill type crusher will be ventilated at a rate of 4000 cfm and the discharge loadings would be in the order of 10 grains/ft^3. Based on the operating cycles for Phases 1 and 2, coal dust emissions have been calculated in potential Appendix G . In Phase 1 the uncontrolled emissions are estimated to be 370 tons/yr. and for Phase 2 they would be 1900 tons/yr.

Without equipment arrangement details, it is assumed that four conveyors will be required for Phase 1 operations and eight for Phase 2, operating on the same cycle as the crushers. Uncontrolled emissions from the conveyors have been calculated to be 290 tons/yr. and 1500 tons 1 yr. for Phase 1 and Phase 2 respectively. Therefore the total uncontrolled emissions from the coal processing area are estimated to be 660 tons/yr. and 3400 tons/yr. for Phases 1 and 2, respectively.

The application of emissions control equipment is mandatory for this type of process equipment. The use of fabric filters, which would reasonably provide a 99 percent collection efficiency would be provided for their operations. Therefore the actual emissions during Phase 1 and Phase 2 operations would be estimated at 6.6 tons/yr. and 34 tons/yr., relatively insignificant levels.

Truck Transport Emissions: In Phase 1, the mined and crushed coal will be transported by diesel trucks approximately 30 miles to Craig. Based on a truck capacity of 30 tons, for the 600,000 tons of coal being mined each year over the three-year period (comprising Phase 1) there would be required 20,000 one-way trips or 40,000 round trips. The total truck miles traveled annually for the Phase 1 operation and the expected emissions are shown in Table 38 . Compared to the fugitive dust emissions during Phase 1, the total truck transport emissions value of 81.1 tons/year during Phase 1 operations is insignificant.

Another emission source to be considered during the truck transport phase is that of fugitive dusts from roadway travel. However, because the road from the loadout station to Craig is, or will be, paved, such emissions will be negligible.

TABLE 38

DIESEL TRUCK POLLUTANT EMISSIONS
(Travel from Loadout to Craig [30 mi] during Phase 1)

Truck-Trips Per Year	Truck-Miles Per Year	Emissions—Tons/Yr.					
		Particulates	CO	HC	NO_x	SO_x	Total
40,000	1,200,000	1.7	27.0	4.3	44.8	3.3	81.1

The use of truck transportation for the transfer of coal between the mine lookout station and the town of Craig is presently being evaluated for Phase 2 operations. Feasibility studies are being undertaken to determine the optimum transport made during years 4 through 16 when the mine production rate is planned to be at a level of 3,000,000 tons/yr. Thus such coal transport means as truck, unit train, slurry pipeline and mechanical conveyor will be considered in this evaluation.

Ultimate Emissions: The quality of the coal to be mined is excellent. Heating values in the range of 10,500 to 11,500 BTU/lb, sulfur contents of 0.3 to 0.5 percent and ash analyzing about 8 percent would produce minimal SO_x and flyash emissions during its combustion. The low sulfur value of the coal will find a ready market at premium prices because of the demand for low sulfur coal by coal fired steam power plants in the mid-west and eastern United States. Air Pollution Control District Regulations throughout the nation generally prohibit the combustion of coal having a sulfur content in excess of 0.5 percent which is equivalent to a stack discharged SO_2 concentration of about 350 ppm.

Thus, the coal being provided during Phase 2, at the rate of 3,000,000 tons/year, has the potential to be converted to electrical energy at a generation capacity of one million kilowatts with minimal air pollution impacts. The availability of this quality coal for electric power generation with such minimal impact to the condition of the nation's air resources should be recognized.

Indirect Source Emissions: Those indirect source emissions associated with increased motor vehicle travel resulting from the mine operation should be minimal. It has been estimated that approximately 95 employees will be required for operation of the mining facility during Phase 1 and 280 during Phase 2. Both numbers, as related to the generated motor vehicle volumes, are well below the criteria defined by EPA for "indirect source" planning. The Federal Government (EPA) is concerned with fac-

ilities which would require 1,000 or more parking spaces. A number of the states, in the enactment of their own regulations for the control of indirect source emissions, have lowered this value to 500 parking spaces; still well above the predicted parking requirements for this proposed coal mining operation up through Phase 2. Therefore, an indirect source analysis for motor vehicle activity will not be performed.

Still another factor to be considered is the growth-inducing impacts of the proposed facility. Industrially, coal conversion plants in the area of the mining operation are not being considered so that such stationary industrial source emissions do not have to be evaluated. While socio-economic and demographic factors, which would foster population growth in the surrounding area, would have to be considered for their air pollution impact, these effects were not considered sufficiently significant to be treated in this section.

Spoil Pile Fires: Spoil pile fires may occur from time to time in the overburden due to spontaneous combustion of small amounts of coal. Efforts should be made to fragment, disperse, and bury any coal within the overburden to limit spoil fires. These fires could result in short term visible smoke emissions.

B. THE BIOLOGICAL ENVIRONMENT

The ecology of the mined area will completely be disrupted during the operation of the proposed surface mine. According to the mining plan, approximately 1,800 of the 2,560 acres of the Colowyo mine property will be surfaced mined over a period of 15 years. The surface mining process will naturally require the removal of all topsoil and overburden material on top of the coal seams to be mined.

The destruction of this vegetation will remove wildlife habitat and will disrupt the animal populations in the immediate vicinity of mining activity. Destruction of the plant cover will also destroy or force the migration of small mammal populations, such as mice and pocket gophers, which are the normal food source for hawks, foxes, and other predatory animals. In the absence of suitable habitat on the surface mine site, the browsing animals, such as elk and deer, will be forced to graze on adjacent areas. This could produce an unfavorable grazing condition on the range to the periphery of the mining area. This reduction of habitat on the property will persist for approximately 15 years, during which time surface mining operations will be in progress. Allowing a period of 20 years for full restoration of the habitat, it can be anticipated that the surface mined portion of the property will not provide suitable big game habitat for 35 years.

The increase in human activity on the property and in surrounding areas will have a greater impact on wildlife populations than habitat removal. Because of the characteristic shyness of elk, the level of human activity in an area is a primary limiting factor to the carrying capacity of elk range.

C. THE SOCIAL ENVIRONMENT

1. POPULATION

Manpower requirements for the Colowyo Mine Company are as follows:

Category	Phase I	Phase II
Management	21	38
Operating Labor	47	96
Maintenance Labor	25	52
Total Estimated	93	186

It is assumed that all employees hired by the Colowyo Coal

Company will be permanent employees. Employees resulting from construction of mining facilities will be employed by the subcontracting companies and will most likely be transient employees without families. The number of construction employees are estimated to be at a maximum of 100 employees. Due to the uncertainty of the number of construction employees, the impacts of this population group have not been discussed.

Service-related employment resulting from proposed mine-related employment can be calculated by using a multiplier of 1.5 persons per employee. Table 39 gives the estimated population resulting from mine and service-related employment.

TABLE 39

PROPOSED POPULATION RESULTING FROM THE COLOWYO MINE

Category of Employees	Number of Employees	Total Persons Per Dwelling Unit		
		3.0	3.5	4.0
PHASE I				
Permanent Employees	93	279	326	372
Service Employees (1.5 multiplier)	140	420	480	560
Total Population	233	699	805	932
Total Range		699-932 persons		
PHASE II				
Permanent Employees	186	558	651	744
Service Employees (1.5 multiplier)	279	837	977	1116
Total Population	465	1395	1628	1860
Total Range		1395-1860 persons		

Sources: Mining Employment estimations given by the Colowyo Coal Company; 1.5 Multiplier is from Denver Research Institute; Calculations from VTN.

Family size is based on 3.0 to 4.0 persons per dwelling unit, which gives a high and low estimate of population. It is estimated that 3.5 persons per dwelling unit is a reasonable family size resulting in a population of approximately 800 persons for Phase I and approximately 1,600 persons at peak development of the surface mining operation.

During the life of the project the population characteristics of the whole area will be changing. The past has been characterized by a stable population with a tightly knit social fabric. While there has been an influx of seasonal agricultural workers, by and large people know most other people in their communities. The percentage of those employed in agriculture relative to those in more commercial industrial types of employment will decline. Some new residents will consider the area a temporary home and will not necessarily share the same values and priorities as do current inhabitants. The community will become less homogenous.

The major population impacts are expected to occur in the vicinity of the mining operations and in Craig or Meeker; however the availability of housing is an important factor in determining population location.

The impacts of increased population are ones of secondary nature and result due to the location of population settlement. They are such things as increased usage of public services and utilities, increased safety problems, increased demand for housing and school facilities, and resultant growth attraction, based on the assumption that growth attracts more growth in the form of increased business opportunities and its resultant population. Therefore, the 1.5 service multiplier effect is used to calculate secondary growth and is evidenced on Table 39.

2. EMPLOYMENT AND INCOME

The regional and national demand for qualified and experienced mining employees may make a training center a viable opportunity for area recruitment, and Rangley College is considering a program of this nature. Since trained manpower is in relatively short supply in the western states some of the young men from the area, the unemployed and farmers wishing to supplement their income will have an opportunity to be trained for work in the Colowyo mine. The regional pattern will be changing from agricultural to industrial employment. The change in distribution will have fewer impacts if the industry attracted by mining development is diverse enough to support the population and its needs.

It is quite possible that construction workers and the new

permanent employees will have incomes significantly higher than present county residents due to the inflation of wages in the United States. And the projected demand for the limited number of available trained mining personnel will increase mining personnel wages. Rising prices may result from an increased demand for goods and services. This would have an effect on people with fixed incomes and those whose incomes are not tied to the expanding sectors of the county economy such as mineral resources. Unemployment rates, already low, are predicted to decline even further in the short-term as new employment opportunities open. However, as more people are attracted to the area due to employment opportunities, the unemployment rates will reflect the saturation of the employment in the area. The impact of this employment growth may cause temporary inconsistencies in wage earnings in all employment sections, however, this situation, if it occurs, should stabilize within a short time due to manpower competition.

3. ECONOMIC BASE

Income: Industry income multipliers are useful in assessing the total impact of resource use in a community or area. The economy is a complex set of interrelationships between initial users, processors, final users, and service activities. These interrelationships are the mechanism by which income is generated in the local economy. A multiplier effect can be expected on income as the new money generates additional activity in the economy.

The income multipliers are based on the propensity to locally consume local production and the contribution to economic growth brought by the flow of export earnings. A multiplier has two effects: 1) the primary effect is equal to a factor of one and represents the initial amount of income added to the economy by the sale of goods or services; 2) the multiplier or expansion effect can be interpreted as the additional income generated elsewhere in the economy. For example, for each additional dollar of direct income generated in the fossil fuels mining sector, $0.38 of income is generated elsewhere in the regional economy. A $1.00 decrease in income produces a negative effect as the loss is felt in other sectors.

The regional summary multiplier shows only the expansionary effect of a new dollar of income injected into the local economy, created by a non-resident tourist ($0.41).

The more developed and complex the local economy, the greater the multipliers tend to be. Purchasing power stays in the more developed economy longer before it "leaks out" for expenditure on goods not locally available. More local service employment is generated per income dollar from basic employment.

Multipliers help to forecast changes in the economic structure as well as the size of the population generated by any new employment activity. Different multipliers for the tri-county area have been calculated as given in Table 40, to approximate the relative contributions of each of the twelve major sectors.

The employment and income associated with mining development falls into three categories: construction, plant, and local service. Construction employees for the first phase of the project will for the most part be without families and will be transient partly due to existing lack of housing and services in the area. Any phase two construction workers will be more likely to bring families as their period of employment will be greater. Therefore, the value added per employment dollar for construction workers is low, 1.087.

Mining or plant employees will have a more permanent work situation. During phase two these employees will bring in families and establish themselves as part of the community. The income multiplier for these employees is therefore greater, between 1.35 and 1.38.

Local service employees may represent two employees per family or the spouses of plant employees. Of the local service employees generated by mining development, up to 50 percent in each phase may be accounted for as second family incomes. The service employee income multiplier is 1.112 as shown in Table 40.

Other incomes associated closely with mining development are transportation and federal government. Coal will be trucked from the area. The Bureau of Land Management will likely be bringing in new employees to handle leases and to oversee reclamation.

The amount of money injected into the economic base of Moffat County for a population of 100 construction employees, 93 mining employees and 140 service employees as seen in Table 41.

TABLE 41

INCOME GENERATED BY COLOWYO MINE

93 Mining Employees	x	$11,500	x 1.385	=	$1,475,910
100 Construction Employees	x	10,000	1.08		1,080,000
140 Service Employees	x	8,000	1.11		1,243,200
			Total		$3,799,110

Source: Prepared by VTN.

TABLE 40
TRI COUNTY
EARNINGS AND INCOME MULTIPLIERS BY MAJOR INDUSTRIAL SECTOR, 1970

Industry	Earnings ($1,000)	Industry Income Multiplier
Agriculture		
Livestock (Ex. Dairy-Poultry)	$ 8,621	1.334
Other Agriculture	2,319	1.047
Mining		
Metal	$ 343	1.364
Fossil Fuels	7,962	1.380
Quarrying	483	1.349
Contract Construction	$ 4,483	1.087
Manufacturing		
Food and Kindred Products	$ 65	1.001
Lumber and Wood Products	614	1.167
Other Manufacturing	564	1.011
Transportation & Communication	$ 1,601	1.032
Public Utilities	$ 2,085	1.181
Wholesale & Retail Trade	$ 6,782	1.149
Finance, Ins. & Real Estate	$ 966	1.000
Services	$ 6,371	1.112
Recreation	NA	
Government		
Federal	$ 2,706	1.411
State & Local	6,186	1.000
Region Summary	$52,151	.411

Source: Bureau of Land Management

Taxes: The Colowyo Mine will have beneficial impacts on the tax base of Moffat County through increases in assessed valuation. As each acre becomes producing coal land, its assessed value doubles from $520 to $1,040 per acre. Coal land improvements (buildings, etc.) will also be assessed. It is impossible at this time to accurately calculate the assessed value of the Colowyo Mine's surface acres (2,565 acres). Part of the acreage will be producing and part non-producing. The additional tax base due to mining will be large, and will support the additional county expenditures. The assessment of natural resource land is due to change.

According to J. I. Kitch, Moffat County Assessor, Moffat County will probably change its method of assessing coal lease areas within two years to reflect the value of the land as that applies to production. The total lease and annual production will be reflected by the following formula:

Assessed valuation will equal the total royalty paid to the State, 20¢ per ton, times the total tonnage production to equal net value. This amount times 11.5 percent equals the actual capitalized value which in turn is assessed at 30 percent. This "landlord" method is recommended by the Bureau of Taxation and is similar to the one utilized for oil production currently.

For the Colowyo Mine Company property (of approximately 2,560 acres), an annual production of 3,000,000 tons x 20¢ = $600,000 royalty. At a rate of 11.5 percent, this would equal $69,000 capitalized actual value x 30 percent equalling $20,700 assessed valuation.

Capital Expenditures for Colowyo Mine for equipment, facilities, rights-of-way and leases come to an estimated $68 million which will be taxed. Of this, $22 million represents equipment or personal property. A gross ton/mile tax and a five percent corporate tax on all Colorado-derived sources of income will be collected.

Money injected into the local economy from employee settlement will vary depending upon place of settlement, average family size, etc. In general, per capita local government and municipal expenditures for counties of populations less than 10,000 are summarized in Tabular Form in Appendix E.

4. COMMUNITY AND SOCIAL SERVICES

Housing: The increase of population will bring special problems in the areas of housing, education, utilities, social services and transportation. The expansionary effect is already occurring in Craig (Moffat County) due to the Colorado-Ute Power

TABLE 42

PROJECTED HOUSING REQUIREMENTS PHASE I & PHASE II—ALL EMPLOYEES

Housing Needs Moffat County Phase I	Total	Mining Employees	Service	Construction
Owner***	163-193	40-50*	80	43
Rental	142-162	25-45	60	57
Total Units**	325			
Phase II				
Owner	232-242	80-90	132	20
Rental	203-233	80-110	99	24
Total Units	450			

*These requirements are not calculated to include growth other than Colowyo Mine.

**These figures do not include occupied standard unit replacement and occupied substandard unit replacement.

***4 owner/3 rental for permanent employees.
3 owner/4 rental for temporary employees—calcualted from the Colorado State Housing Board & Division of Housing, "1972 Project Completion Report."

Source: Prepared by VTN.

Association Electrical Generating project. Unless some housing and municipal development takes place before the Colowyo mining employees come into the area, they will face housing shortages as well as overburdened and overcrowded public facilities and services.

Housing demands during phase one will be minimal for construction workers. Housing needs will be temporary consisting of mobile facilities brought by the employees themselves, such as campers, trailers and mobile homes. Their needs will be limited to utilities and community and social services. It is also estimated that some temporary employees will utilize available rentals (housing apartments and motels-hotels).

The demand can be estimated for mining employee housing needs, exclusive of construction workers needs, of between 40-50 permanent on site homes or apartments for families and between 25-45 mobile homes or apartments for singles and young marrieds. Good planning and the market could serve to alleviate the severity of the demand as discussed in the next section. Phase two will place greater demands upon permanent housing. Mining employees will need from 80-120 mobile homes, or apartments, and 80-90 permanent on-site homes, the exact density mix is indeterminant at this time, see Table 42.

Much local service employment represents two employees per family, the proportion seeking housing could thus be estimated at two-thirds of local service employment. Phase one service employees may need 140 dwelling units and in Phase two, 230 dwelling units. This estimate may be high since many service workers could already live in the community or could be spouses of incoming mine workers. It is possible that the majority of service employees will be new to the area since current employment levels are low.

Utilities: Utilities will be most affected by overloads which may be avoided since most towns in the area have applied for additional Federal funds for extension of their utilities (see utilities section, Existing Environment).

Water needs, given in Table 43 below, may be provided with few additional problems, depending upon the extent of water needs. Land is available for landfill areas and capital for the purchase of these areas should be available before present capacities are saturated, with the exception of Steamboat Springs which is presently over capacity. Craig and Meeker have anticipated sewer capacity saturation and have made application for study grants to plan for future development. Increases in the provision of power for future population by Yampa Valley Power and Electric Company and Greeley Power Company will not constitute a problem.

TABLE 43
WATER/SOLID WASTE NEEDS RESULTING FROM COLOWYO MINE AND MINING RELATED EMPLOYMENT

Category	Population	Water Use* (gpd)	Solid Waste Fill Area** Acres
Mining Employees and families	651	65,100	.22
Service Employees and families	977	97,700	.34
Total employees and families***	1628	162,000	.57

*Based on a coefficient of 100 gallons per capita per day (gcpd) and given in total gallons per day (gpd)

**Based on a coefficient of .35 acres per 1000 population per year.

***Does not include construction employees.

Families based upon 3.5 persons per dwelling unit.

Source: Prepared by VTN

Social Services

The estimated population growth can be looked upon as having both beneficial and adverse impacts: beneficial from the standpoint of increased availability of employment opportunities, goods and services; adverse because of increased demand on utilities, schools, community protection, and the elimination of open space. Proper planning will play a crucial role in the mitigation of any adverse impacts. The degree of impact by the proposed Colowyo Mine on the various social services is discussed in the appropriate section.

Police and Fire Protection: The expansion of police and fire protection to serve the new population resulting from the Colowyo mine is calculated to be 1.9 per 1,000 or 1-2 new policemen Phase I, and 2-4 new policemen for Phase II. For an incremental population of 1,000, the police protection costs are

estimated at $11,780 (THK and Associates). Fire protection for the City of Craig is already deemed inadequate for its size, since a town with a population over 5,000 should have a permanent rather than a volunteer fire department. Estimated costs for Craig for a paid department to serve a population of 10,000 (1977) with high and low levels of service would be as follows:

TABLE 44

ESTIMATED COST FOR FIRE PROTECTION IN CRAIG TO SERVE A POPULATION OF 10,000 IN 1971

Category	High Estimate	Low Estimate
Personnel	400,000	300,000
Equipment	100,000	50,000
Stations	30,000	20,000
Total	530,000	370,000

Source: Bureau of Land Management

A low level of fire service assumes a manpower force of 30 employees at $10,000 per year per employee, and a high level assumes 40 employees at the same cost per year per employer. For an incremental population of 1,000, the fire protection costs are estimated at $21,545. The impact resulting from mining development would be both beneficial and adverse on the fire department of Craig, since it necessitates an expansion needed, although costly, of fire facilities and fire department status.

Commercial Facilities: Growth impacts on commercial facilities, such as banks, stores and services, tend to be considered beneficial since they bring business and increased profit. Commercial facilities are also attracted by growth and respond to market demands within a relatively short period of time. Therefore the provision of these facilities should not constitute a problem.

Community Facilities: Churches, hospitals and public agencies present a special problem in that they must have a greater lead time to expand facilities due to financing. Tremendous start-up costs may mean inconveniences and poor service for newcomers and inhabitants alike. Tax revenues, unless new sources are

planned for and expanded now, will not generate enough funds to take care of expansion as it occurs. This problem is particularly pertinent in supplying health facilities within the total tri-county region. Its solution is problematic, and should constitute intensive study efforts in order to mitigate health facility deficiencies.

Education

Officials of school districts in the Meeker (Rio Blanco County) and Craig (Moffat County) corridor area have expressed an awareness of the possibility of rapid growth resulting from new industry. According to officials in both Meeker and Craig, existing facilities are either filled to capacity now or will soon be seriously overcrowded.

Mr. Robert King, the Superintendent of Schools, Rio Blanco County estimates a 10 percent increase in enrollment by the middle of the 1974-75 school year. This is due in part to the expected opening of several new industries, as well as some proposed oil shale development in the area.

This kind of growth will have an impact on existing conditions. The high school building is in good condition, but it is felt that eight more classrooms must be added to adequately meet future needs.

The junior high school building is 50 years old and in poor condition. This will constitute problems until funds are available to construct a new building. The elementary school building is in good condition and it is felt that it will be able to handle projected growth for the next few years.

The Moffat County School District is aware of the possibility of rapid growth related to new industry, and is already planning to expand existing facilities to meet these needs. According to Mr. Ray Merrick, Assistant to the Superintendent of Schools, Moffat County, the district expects considerable growth to occur within the next few years also due to the opening of several new industries in the area. Based on a multiplier of 1.8 school-age children per family, present enrollment is expected to double within the next two years.

With the exception of the high school, which is presently filled to capacity, there is room for growth in all other schools. The high school must find new classrooms by this fall, to facilitate existing growth. There are plans to replace this facility in the next three years so impacts will be short term. The junior high school, built about six years ago, may be expanded with class-

rooms in the old high school building when the new high school is built.

Using the 1.8 school aged children per family ration, Table 45 following gives estimates of school aged children resulting from the Colowyo Mine development.

TABLE 45
NUMBER OF SCHOOL CHILDREN RESULTING FROM MINING DEVELOPMENT

Category of Employees*	Number of Employees	Number of School Children** (1.8 per family)
PHASE I		
Permanent Employees	93	101
Service Employees (1.5 multiplier)	140	252
Total	233	353
PHASE II		
Permanent Employees	186	336
Service Employees (1.5 miltiplier)	279	501
Total	465	837

*This is assuming that each employee constitutes a family. This does not include construction employees.

**Rounded up to the nearest figure.

Source: Prepared by VTN based on school district estimations of number of children per family and Colowyo Mine Company estimations of number of employees by Phase.

It should be noted that, while students resulting from the Colowyo Mine development will increase the student load in the school districts, it will be the cumulative effect of increased development which will determine the extent of the degree of impact on the schools. Viewed by itself, the Colowyo Mine development, will cause a short-term impact until school facilities can be adequately provided to facilitate incoming students. Temporary classrooms are usually utilized or split sessions offered to take care of new students until new classrooms are built.

Recreation: The proposed mining operations will have no significant adverse effect on the recreational aspects of the area. The region immediately surrounding the site is used primarily for hunting deer and other smaller game, however, usage of this area is low, according to the State Department of Game and Fish. Mining operations will disrupt the habitat of these animals causing them to range elsewhere. This will most likely increase hunting in other areas, rather than deter existing hunting potentials. During the summer months, traffic on Highway 13, adjacent to the Colowyo Mining activities doubles itself with tourists traveling to the many recreational facilities farther north. The 30-ton coal trucks may impact upon tourist travelling enjoyment by causing impairment to traffic flow.

Transportation: There are three aspects of the Colowyo Mine operation which have salient effects on transportation. First, there will be a general traffic increase with a resulting increase in risk of accidents due to employee commuting as well as from the hauling of coal. Secondly, potholes and other road damages on highways created by the unavoidable freeze-thaw action in the winter months will be aggravated by the transport of filled coal trucks over the winter damaged roads. Thirdly, dust and dirt carried onto the road will create a maintenance problem and hazard to normal traffic. Although the first two impacts are unavoidable, the third can be mitigated. Mitigative measures are discussed in the following section of this report.

4. LAND USE AND ZONING

Changes in land use will unavoidably change and possibly reduce availability of agricultural land, mostly rangeland, and will cause the expansion of present communities both by annexation and by zone changes for higher density. The potential adverse impacts will be to farmers who presently graze their cattle on the leased land. The total surface acreage of the proposed Colowyo Mine will support 65-85 cattle for one year (Department of Fish and Game). Secondary impacts to existing land use in communities, because of the population increase, will be the conversion of open space to urban and built-up land use. The Colorado Division of Planning recommends the following standards for estimating future land use demands:

residential	10 acres for each additional 100 persons
commercial	.8 acres for each additional 100 persons
industrial	2 acres for each additional 100 persons
public/semi-public	3 acres for each additional 100 persons

These figures are applicable for estimating future land use demands for projected population resulting from mine development.

For the Colowyo Mine, the following estimates would apply for a population between 1,400 to 1,800 persons:

residential:	140 - 190 acres
commercial:	11 - 15 acres
industrial:	28 - 38 acres
public/semi-public	42 - 57 acres
Total acreage needed:	221 - 400 acres

Further delineations of acreage needs by community services are given below for a population between 1,500 to 2,000 persons:

Education	9 - 12 acres
Recreation	15 - 20 acres
Libraries	.21 - .28 acre
Hospitals	.38 - .5 acre
Fire Protection	.11 - .14 acre
Police	.09 - .12 acre
General Financial	.006 - .008 acre
Public Works	.045 - .06 acre
Water Supply	1.5 - 2 acres
Sewers	1.5 - 2 acres
Streets	26,5 - 36.6 acres
Total acreage needed	55 - 74 acres

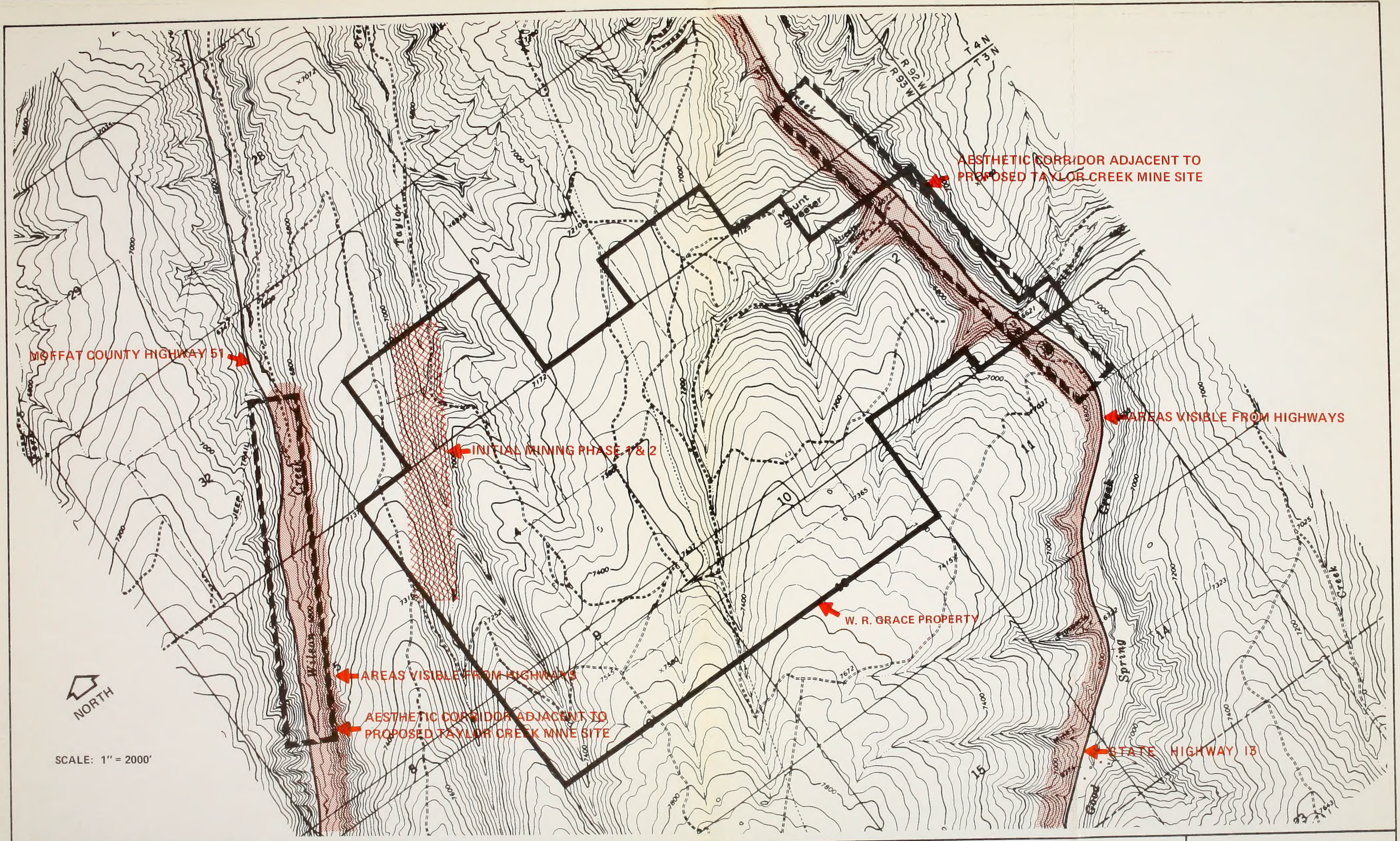
6. ARCHAEOLOGY, PALEONTOLOGY, AND HISTORY

There do not appear to be any significant archaeology, paleontology, or historic sites on the property. According to Dr. David A. Breternitz, nothing of archaeological or paleontological significance is expected to be found in this area. A scheduled walk through of the site will take place this summer as per requirements of the State Historical Society of Colorado, the Federal Antiquities Act of 1906, and Executive Order 11593. This will be available as a seperate document.

7. AESTHETICS

The property is bordered to the east by Colorado Highway 13 and to the west by Moffat County Highway 51. The aesthetic impacts will be minimal, as viewed from the highways, and do not appear to be significant in terms of secondary impacts. Figure 29 delineates the visual corridors along the two highways and the areas seen from the highways. The areas to be surface mined lie in the valleys that could not possibly be seen from either highway. Tourists using Highway 13 for sightseeing and access to the recreation areas further north will, most likely, be unaware of the ongoing mining activity. They will, however, be aware of the 30-ton trucks transporting coal to the railhead at Craig. This may pose a problem in the event that Colorado Highway 13 is designated as a scenic route by the State. According to Mr. Gene Miller of the BLM's Resources Department, the State has no such plans at present.

Tourist viewing pleasure could be impacted by the unimproved access road to the property from Colorado Highway 13. Vehicles entering and leaving the property will raide dust that may obscure the vision of other travelers. This can be partially mitigated by dust control measures, however some obstruction due to dust and general road cut conditions is unavoidable. Paving of the access road would provide total mitigation but might not be economically feasible.


AESTHETIC CORRIDOR ADJACENT TO PROPOSED TAYLOR CREEK MINE SITE
MOFFAT COUNTY HIGHWAY 51
AREAS VISIBLE FROM HIGHWAYS
INITIAL MINING PHASE 1 & 2
W. R. GRACE PROPERTY
AREAS VISIBLE FROM HIGHWAYS
AESTHETIC CORRIDOR ADJACENT TO PROPOSED TAYLOR CREEK MINE SITE
STATE HIGHWAY 13
NORTH
SCALE: 1" = 2000'
T4N
T3N
R 92 W
R 93 W
Taylor
Mount Streeter
Wilson Creek
Good Spring Creek
JEEP
28
29
32
2
3
8
9
10
11
14
15

vtn

VISUAL CORRIDORS ADJACENT
TO W. R. GRACE PROPERTY

SOURCE: PREPARED BY VTN

FIGURE 29

PROPOSED MITIGATION MEASURES

VI. PROPOSED MITIGATION MEASURES

A. INTRODUCTION

Increasing awareness of environmental quality and economic development requires comprehensive plans to mitigate impacts which may develop from a given project. Numerous governmental and private agencies are involved in advising on such matters. The Bureau of Land Management has produced a Comprehensive Unit Resource Analysis (Williams Fork Study, 1973) which generally covers northwestern Colorado. This report, however, deals with specific impacts and mitigations to given biological, geological and social situations. As such, it provides important information for designed reclamation plans. When the Colowyo Coal Company initiates their reclamation plan, the Unit Resource Analysis should be reviewed and those applicable mitigation measures suggested be employed. The following mitigation measures are specific to the subject mining activity to supplement the Williams Fork Study.

B. LAND RECLAMATION

The mitigation of the expected impacts to the biological environment are dependent upon a successful land reclamation plan. This revegetation plan must consider present landforms, angle of the slopes, soil types, vegetation, and wildlife.

Revegetation plans must be centered around species that naturally occur in areas where the growing season is short--generally less than 90 days, and rainfall low--approximately 16 inches per year. Presently, the mining plan calls for stockpiling of topsoil (see Section III) for this revegetation program. This should mitigate any toxic characteristics of the overburden material. As the land becomes available for reclamation, the topsoil will be replaced and contoured into slopes and grades similar to those presently existing. Since the end result is to create a biological community as good as or better than the existing conditions, the processes of natural plant succession must be incorporated into the plan. As mentioned earlier, the primary biological impact of the Colowyo Mine will be the removal of the existing vegetation and thus the range displacement of wildlife and cattle. Promoting natural succession will mitigate these impacts. To accomplish this end, however, the revegetation plan must employ numerous native perennial plant species to initiate the processes which will produce a stable ecosystem. It is possible that initial reclamation will require the application of fast-growing annuals for prevention of erosion while the perennial species establish themselves. If this is the case,

detailed soil analyses will be necessary to indicate the nutrients necessary to enhance the growing potential of the soils.

During the life of the mine, it may be necessary to prevent wildlife and domestic livestock from drifting onto the property. The Colowyo Coal Company property does lie within the winter feeding ranges of the mule deer and elk. Fences will be erected to discourage animals from entering the mine site. The adjacent lands, however, should be able to support the displaced population.

Since it is the expressed intention of the Colowyo Coal Company to produce a productive landscape after the mining is complete, recommendations will be solicited from the Soil Conservation Service, the Bureau of Land Management, Colorado State University, and other knowledgeable agencies or persons.

C. PHYSIOGRAPHY AND LANDFORMS

Alteration and lowering of the land surface would, at a given time, be in local areas and would progressively encompass the greater percentage of the delineated site. Maintaining the operation in limited portions of the property at any one time would lessen the short-term impact on landform alteration and destruction, in that reclamation could be progressing on previously mined areas while some unmined natural areas still exist. Utilization of proper engineering investigation and planning willenable prediction and control of the amount of lowering of the ground surface relative to the coal seam thickness removed. Proper placement and compaction of the stripped overburden (spoils) will diminish the effects of altering the land surface. This should also preclude future subsidence and settlement problems which result from consolidation of poorly compacted materials.

All mined areas and their associated modification to the landscape should be free of unnecessary scarring and destruction of natural topography and landforms. Contouring of the reclaimed land can be made to approximate the natural conditions. Drainage should be controlled in order to prevent excessive gullying and destruction of existing topography both during and after the mining operations.

D. GEOLOGY

1. STRATIGRAPHY AND STRUCTURE

Detailed geologic mapping of the areas excavated to supplement existing data from drill cores will be conducted concurrent with the stripping operations. This would be an effective method of permanently recording stratigraphic and structural information that is necessary for regional and local interpretations that would otherwise be lost by excavation and refilling operations.

Cut-slope stability and possible setback requirements for equipment and structures to be located adjacent to slopes can be determined prior to stripping operations through geologic and engineering studies.

2. SOILS

Quality control procedures will be implemented during excavation, transportation, and stockpiling of soils to mitigate the effects of material losses, erosion, and dilution (due to mixing soils) of nutrient content. Nutrients added artificially to soils would enhance revegetation efforts.

Surface waters will be controlled to inhibit excessive sediment transport during periods of runoff. Selective mixing of the high clay-content soils with sandy overburden materials or soil type 2 (loam) would improve permeability and decrease the shrink-swell potential. Proper placement and compaction will reduce erosion potential and provide increased strength characteristics over those of existing soils.

3. GROUNDWATER

The potential indirect impact on the surrounding stream valley aquifers caused by surface water from the mining area (which may contain abnormal total dissolved solids and chemicals in solution) infiltrating aquifers can be reduced by retaining these waters on the site and/or implementing purification procedures if necessary.

Sump water from the pit excavation may be used for plant operations purposes, such as spraying for dust control, in lieu of developing wells in the vicinity, or transporting water from other areas.

E. WATER RESOURCES

1. DRAINAGE

Sound engineering design of drainage facilities will help minimize the impacts on present drainage patterns caused by the temporary relocation of sections of stream channels subject to mining activities. Design parameters will include proper culvert size and placement to contain the 100-year frequency flood. In addition, proper terracing of the rebuilt stream valley after the extraction of the coal is completed will facilitate return to the original drainage pattern.

2. EROSION

Minimization of flow velocities over stripped lands and through drainage facilities will help control downstream erosion. A comprehensize program of revegetation will also aid in this regard.

3. WATER QUALITY

Proper control and disposal of maintenance wastes will essentially eliminate pollution of surface waters from this source. Construction of impoundments to contain "produced" waters will serve to reduce suspended solids concentrations. Further, these ponds will serve to contain waters for subsequent treatment if this becomes necessary.

F. POLLUTION CONTROL

Fugitive dust emissions from the overburden removal and coal mining and handling will be subject to the provisions of the Colorado Air Pollution Control Regulation Number One Section II D, regarding the control of fugitive dust; effective August 1, 1974. A plan for fugitive dust abatement and preventative measures will need to be outlined including a time schedule for abatement. An air monitoring program for particulates should be set up in order to determine background levels prior to beginning operation and to gather data and monitor the success of the abatement program during operations. Such a program should include high volume sampling and possibly dustfall jars. The air quality data could then be supplemented with surface wind measurements to provide an indication of the impact from fugitive dust and process emissions. A meterological station may be required at the mine site to obtain wind direction and velocity data.

See Appendix F, Regulation Number One for the Emission Control Regulations for Particulates, Smokes and Sulfur Oxides for the State of Colorado.

G. MONITORING PROGRAM

The Colowyo Coal Company will implement an ongoing baseline monitoring program for the lifetime of the mine. This program is outlined in Appendix D.

H. COMMUNITY PLANNING AND ASSISTANCE

1. HOUSING

Lack of available housing is one of the more serious problems resulting from population increases. In Craig and Meeker large residential tracts are currently in some stage of development which should provide some mitigation to housing problems. One of the largest is in Craig, a 385-acre tract which contains 47.6 commercial acres, including a shopping center. There exists a strong possibility that some permanent housing will be available by the time that the second part of the first stage of Taylor Creek mining operation begins; however, the Colorado Ute Power Association project will absorb much if not all electrical power generating of the local housing as it becomes available. In addition to housing development, construction on a 110 unit Holiday Inn is scheduled to begin July 1, 1974 which will supply some temporary facilities for construction and mining employees until other housing becomes available.

The Colowyo Coal Company may find that assisting local planning agencies in their community planning process a beneficial measure which allows for better housing location planning to meet their manpower housing needs.

The Colowyo Coal Company should consider negotiating with a planned trailer park development to reserve spaces for a few months in advance of construction activity to mitigate temporary housing problems or provisions for on-site housing through trailer hookups to reduce some of the first influx of construction workers may also be a mitigative alternative.

2. COMMUNITY SERVICES

The shortage of community services could be minimized by encouraging the city and county agencies to stress the need for these

facilities either by encouraging private services to locate in the area or by providing a public or federal funging to implement programs. Areas of specific concern are police and fire facilities and public health services.

3. EXTENSION OF UTILITIES AND HIGHWAYS

The need for water and sewage treatment facilities has been recognized and applications for grants have been submitted. However, in the event that these grants are not approved, or if the community cannot raise the necessary matching funds, or if the resulting services are not enough to provide for the population increase, some other measures to supply needed services nust be taken. As one alternative, new sales taxes, user fees or increases in ad valorem tax rates could be initiated now to provide future funds when most needed. One measure taken last year was to double the assessed valuation of natural resource lands. For instance, the Colowyo Coal Company now pays 1.5 times more taxes than a year ago which provides an increase in funds to facilitate utility expansion.

Controlled incremental increases in demand can be encouraged by good planning and market analysis. Companies can minimize the fluctuations caused by growth by providing city and county planners with population estimates as they become available. Public relations can also be improved through developing and maintaining community contacts and advising when significant changes of plans are occurring.

4. EDUCATION

Educational and busing facilities in both Meeker and Craig are limited at the present. Although portable classrooms and other temporary situations are available, they are not the preferred solution. The Colowyo Coal Company will work closely with local officials so that projected numbers of mine personnel are known as far in advance as possible. In this way, time can be given to more careful planning to meet future needs. However, an unavoidable problem in building new facilities is financing. Any community needs time to propose a bond issue at the next election, but a smaller community has more difficulty raising needed funds because of its smaller bonding capacity. Therefore, if necessary, support in the form of loaned facilities from industry in the area may need to be given to minimize school facility shortage.

5. MANPOWER

The Colowyo Coal Company plans to aid local high schools and junior colleges providing mineral related manpower training programs. Aid could take the form of individual scholarships to prospective mining students.

I. ARCHAEOLOGY, PALEONTOLOGY AND HISTORIC SITES

In the event that finds of archaeological, paleontological and historic significance are found on the property during construction, overburden removal, or surface mining, a trained archaeologist, or paleontologist will be contacted to remove the find. In this manner, those objects of importance can be preserved for study.

J. AESTHETICS

Aesthetic impacts resulting from the access road entering onto State Highway 13 can be mitigated by the following suggestions:

1. When the access road is complete, revegetation along the edges of the road near and at the intersection would minimize view of the road especially if revegetation consisted of shrubs and forbes native to the property.

2. If the road is not paved, measures should be taken such as watering to minimize dust problems. It is, however, suggested that at least the intersection portion of the access road where it joins State Highway 13 be paved on appropriate distance which will minimize dust and dirt on the State Highway.

3. The access should be designed so as to minimize traffic disturbance due to truck ingress and egress.

4. If necessary, dust control measures should be used to reduce dust from truck transport between the mine and the rail head at Craig.

UNAVOIDABLE ADVERSE IMPACTS

VII. UNAVOIDABLE ADVERSE IMPACTS

A. THE PHYSICAL ENVIRONMENT

1. PHYSIOGRAPHY AND LANDFORMS

In general, the affected site physiography would be changed and could never be completely restored to its natural condition. Once the prominent resistant bluffs are excavated, their original form cannot be restored by grading the spoils over the mined areas.

2. GEOLOGY

The surface mining process will unavoidably remove and eliminate 90 to 95 percent of the coal seams, will unavoidably lower the ground level and will unavoidably change the stratigraphy and landforms on the property.

3. SOILS

The process of excavating and stockpiling the soils would destroy their natural areal and vertical zonation. Stockpiling would remove the soil material from its natural sources of nutrients and moisture.

4. GROUND WATER

The primary unavoidable adverse effect on groundwater would be the destruction of a portion of the shallow aquifers in the excavated areas which would permanently affect the continuity of subsurface water migration across the site.

5. SURFACE WATER

Direct unavoidable adverse impacts will include alteration of surface drainage patterns, increased erosion potential prior to revegetation, and increased potentials for various types of water pollution.

6. AIR RESOURCES

Unavoidable adverse impacts during mine construction include increased dust production and increased pollutant emissions from construction equipment. Following completion of the proposed mine, the operation will result in increased emission of diesel-generating pollutants from trucking (primarily nitrogen oxides and particulates) into the airshed and fugitive dust.

B. BIOLOGICAL ENVIRONMENT

The only major unavoidable adverse impacts to the biological environment besides the removal of the vegetation will be the displacement of the grazing animals onto adjacent property and the destruction of small mammal populations. It seems unlikely that this will be a substantial burden to the carrying capacity of the adjoining lands since the grazing pressure is not heavy at the present. If this proves to be the case, however, selective thinning of the herds (administered by hunting permits) may be necessary to prevent overgrazing.

In the case of the small mammal population, such as mice, ground squirrels, and gophers, the loss of the individuals in the mined area will have little impact on the dynamics of their general population since their productivity is so high.

C. SOCIAL ENVIRONMENT

Unavoidable adverse impacts on the social environment resulting from the construction of coal mining operations include loss of land area used for grazing, some disruption of livestock grazing patterns, minimal disruption of cultivation, and the problematic impacts of the aesthetic view of open spaces along major travelled roads.

Unavoidable adverse impacts resulting from direct operation of the coal mine include noise, vibration, and use on non-renewable resources. Secondary and tertiary unavoidable impacts resulting from mining employees, service-related employees and their families include the use of utilities, community services, use of natural resources, growth, and pollution.

ALTERNATIVES

VIII. ALTERNATIVES TO THE PROPOSED ACTION

The proposed mine at Taylor Creek is intended to provide high-quality coal (low sulfur, high BTU) to electrical generating plants in the mid-western and southern states required to meet new environmental quality standards. The mining operation must also meet environmental quality standards set by the State of Colorado and the Federal Government. Any alternatives to the project must also meet these conditions to be considered feasible.

There are five basic options available with respect to the proposed actions. These are to A) approve the mining plan as proposed; B) approve the mining plan after modification of some portions of the plan, either mining methods, transportation of coal to its point of use or land rehabilitation plans;C)utilize a different method of mining; D) substitute coal for an alternative source of energy; or E) no action; reject the mining plan altogether.

A. THE APPROVAL OF THE MINING PLAN AS PROPOSED

The approval of the mining plan as proposed would generate the impacts, both beneficial and adverse as outlined in this report. The approval of the mining plan will carry with it stipulations and requirements to insure that the plan will be adhered to. The plan will also include an ongoing baseline monitoring program as delineated in Appendix D.

B. APPROVE THE MINING PLAN AFTER MODIFICATION

Some of the impacts identified and discussed under the heading "Adverse Impacts" which cannot be avoided if the proposal is implemented could be avoided if the mining plan was modified to require the use of one or more of the operational alternatives discussed below. In addition, special conditions could be added to the plan relating to the secondary effects of the mining. Such conditions must be reasonable and, if economically unacceptable to the lessee, could result in the lessee not developing the coal resource.

1. DECREASE IN THE MAXIMUM HIGHWALL HEIGHT

The Colowyo Coal Company plans to mine to a maximum highwall of about 140 feet. Impacts associated with reducing the maximum height of highwalls by 50 percent would be 1) a reduction in the tonnage of coal extracted depending on the local topography;

2) a reduction in the surface area disturbed locally; and 3) mining conducted over a greater area to meet the same production level.

2. CHANGES IN MINING PRODUCTION RATES

Any change in production rate either upward or downward would alter the rate or intensity of the environmental impacts discussed previously in this Statement. If a reduction in production rate were required, it could create a shortage of fuel of this quality to the power plant customers of the Colowyo Coal Company resulting in decreased power production when consumption is increasing, unless substitute sources of supply were obtained. A reduction would also 1) prolong mining activity on the leasehold, 2) prolong the time until restoration is completed; 3) lessen employment at the mine; 4) lessen the acreage disturbed at any one time; 5) lessen annual tax and royalty returns to the State, County and Federal Government; and 6) lessen chances of the company creating an economically viable operation.

If the company were required to increase production above present plans, it would 1) increase the intensity and severity of the impacts described elsewhere in the statement; 2) decrease the time mining and reclamation were conducted in any area; and 3) increase annual tax and royalty returns.

3. ALTERNATIVE MINING FACILITIES LAYOUT

One possible change in the mining plan which might be considered would be to modify the physical layout of the mining facilities. It is possible that a change in the location of crushers, conveyors, roadways, storage facilities, physical plants, etc. could have an effect on the visual impact of the mine which could be detrimental. However, increases of both production costs and fugitive dust could be expected to occur if greater distances were to exist between the various facilities.

4. RECLAMATION ALTERNATIVES

No Reclamation

A possible alternative to the reclamation plan submitted by the Colowyo Coal Company is to not require reclamation of the ground surface that is destroyed or disturbed by the mining

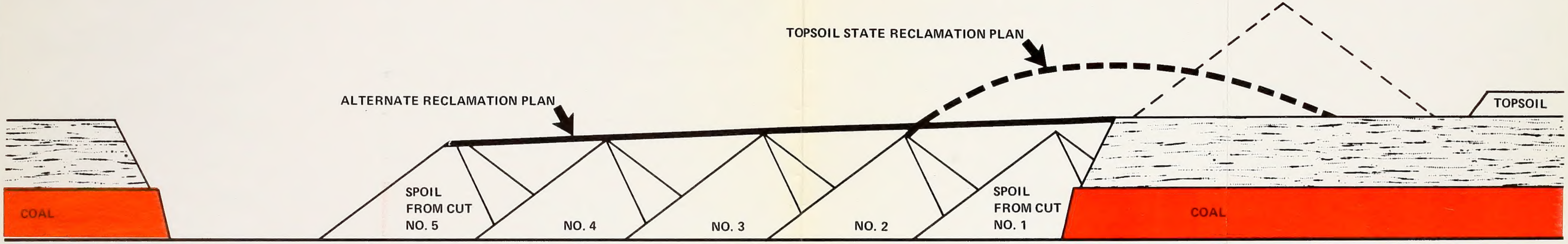
operation. The environmental impacts associated with no reclamation would be increased erosion; loss of forage; destruction of wildlife and habitats; degradation of water supplies, open space qualities, and aesthetics; and a saving in the energy used and the costs associated with reclamation activities. However, such an alternative would violate the terms of the lease, State and Federal environmental protection laws, Federal mining and operating regulations and the Colorado Open Mining and Reclamation Act of 1973.

Reclamation Plans

The following alternate box cut spoil handling (illustrated in Figure 30) demonstrates that if final grading is delayed for four to six cuts, better recontouring and reclamation efforts may result. This is primarily due to the size of the box cut spoil pile. This would have several advantages in addition to better contouring. The first overburden pile from the box cut could be nearly completely removed from the present location and backfilled over a wider area resulting from an additional two to four spoil piles. Actually, this figure demonstrates a fundamental principle: reclamation efforts such as topsoiling and revegetation, where possible, should not be started until the final contouring is achieved, provided other spoil pile deleterious effects such as dust and wind and water erosion can be minimized to an acceptable degree.

Since the surface mining operation will remove four coal seams, the land surface may be below the original level. One alternative to this effect would be to import some form of fill material to decrease this lowering of the surface. This material might consist of solid waste from nearby or distant communities. There are several reasons why this alternative does not appear viable; 1) contamination of ground water by leachates from the landfill material, and 2) the distance from any communities would require additional time, trucks and fuel consumption. Backfilling with inert fill material hauled in from off site locations would also cause deleterious environmental effects to the lands supplying the fill material.

These alternative land uses also require differences in the vegetative cover. Agricultural land use would primarily grow alfalfa, natural habitat suggests exclusively diverse indigenous plant species, whereas recreational land use suggest clusters of shade trees which can also function to isolate camp sites. The possible development of stock ponds or reservoirs should also, in part, be determined by the final land use. Providing there is sufficient surface runoff and groundwater of good quality, water-holding areas could be very



ORIGINAL SPOIL PILE NOT MOVED UNTIL SIXTH CUT

vtn

SCHEMATIC OF ALTERNATE PHASED RECLAMATION PLAN

SOURCE: PREPARED BY VTN

FIGURE 30

beneficial for either livestock and wildlife grazing, agriculture or recreational use.

If the other conditions for a reservoir are met (i.e., sufficient high quality water), a water-holding pond in this location could possibly serve as a year-round water source for cattle and wildlife and/or supply water for agricultural uses. In order to construct such a reservoir, alternative spoil handling and grading would be required.

It might be advisable to select alternative stockpiling locations for the topsoil and overburden. Present plans for storage could be modified to either place the material in a different location or devise a different contouring plan. Since the company intends to seed and fertilize the stockpiles, erosion is not expected to be major. Impacts such as dust pollution and visual would be expected to be the same in either case.

5. PRODUCT TRANSPORTATION ALTERNATIVES

Coal Slurry Pipeline

Coal slurry pipelines have been used to transport crushed coal over long distances for several previous coal mining developments. The most noteworthy being the 275 mile long Peabody Coal Company Black Mesa pipeline in Arizona. Physically, a pipeline constructed underground would be environmentally pleasing since it is invisible, except for pumping facilities. This type of facility has proven to be an efficient coal tranporting mechanism. Electrical energy requirements for transport of the slurry are minimal. However, the system does require substantial quantities of water (on the order of 200 acre-feet per million tons of coal) for formation of an easily transportable coal slurry. Treatment and disposal of the water which is separated from the coal slurry at the downstream end of a pipeline are associated problems. Unless marketing facilities such as a power plant or other suitable user is available, at the pipeline terminal, recovery of the transport water is not feasible and it must be discharged to waste after treatment. Transporting coal by a 26-mile pipeline from the Colowyo Mine site to the railhead at Craig is a possible transportation alternative. The advantages to constructing an underground slurry line as an alternative to trucking the coal include: low energy requirements, relatively low capital costs, minimum visual impacts, no lasting impact on land forms, short term impact on ecology and construction, safe operation, no traffice disruption, relatively low construction costs and no adverse air pollution problems.

Impacts of this alternative, in addition to cost, would be: 1) the securing of a pipeline right-of-way with extra land for in-line support facilities; 2) the obtaining of water rights for the large volumes of water (240 gallons of water per 1 ton of coal) needed for slurry preparation and pipeline transportation; 3) the construction of water and slurry storage facilities resulting in additional surface disturbance at localities along the right-of-way; 4) the construction of additional processing facilities at the mine to prepare the coal for transmission as slurry; 5) the construction of de-watering and treatment facilities; 6) the use of a large tonnage of steel pipe which would be lost to other uses; 7) the use of the energy required to construct and run such a coal slurry pipeline which would not then be available for other uses; and 8) the possibility of pipeline spillage and rupture which could degrade local areas.

Conveyor-belt Systems

Belt conveyors can be considered as an alternative transportation method to other coal transport techniques. It would be possible to build a system of interconnecting conveyor belt units from the mine to the railhead at Craig. Under the existing mining plan and surface conditions, a compound conveyor system would be the most practical. Such systems are designed for applications in areas of undulating terrain. The entire length of the conveyor system would require enclosures to control fugitive dust. A service road would also have to be constructed parallel to the conveyor line for maintenance purposes. In many aspects, the preparation, installation and operation of a conveyor system is analogous to a railroad system. Land requirements for the conveyor system would approximate the right-of-way needs for a single track railroad line. Extensive land areas would be required at loading points and at the terminal point where the coal is to be transferred to other transport systems. Fencing and drainage structure requirements would be identical in most instances. Advantages to constructing a coal conveyor line system as an alternative to truck hauling include: 1) flexibility in relocating system, 2) inexpensive installation costs, 3) minor earthwork needed for right-of-way 4) flexibility in design for irregular terrain.

One disadvantage to coal conveyor-belt systems is that it requires a greater land area to be removed from production over that of a railroad or highway. A conveyor system is more visible on the landscape than most segments of a rail line. Other negative impacts are: 1) loud constant noise throughout the entire length of the line, 2) heavy maintenance requirements, 4) constant surveillance patrols on parallel access roads 5) access across the right-of-way would be inhibited by

the above grade conveyor equipment, 6) entire right-of-way must be fenced to eliminate the hazard to humans, 7) inhibit big game migration.

Railroad Unit Trains

Construction of a railway line from the Colowyo Mine site to the nearest railhead near Craig would be another coal transportation alternative. About 26 miles of railway would be needed to connect the mine with the Denver and Rio Grande Western Railroad east-west line at Craig, Colorado. Rail transportation for coal production of less than one million tons per year is not economically feasible. However, unit coal trains operating one to two times per day could carry the maximum projected output from the Colowyo Mine (three million tons per year). Construction and operation of a railroad line would require the same right-of-way permits as a conveyor system. Advantages of a railroad over other alternatives would include: 1) greater carrying capacity, 2) less visual impacts, 3) low transportation costs, 4) less fuel consumption, and 5) traffic duration is less. Disadvantages to such an alternative would include: 1) greater noise levels as compared to other alternatives, 2) major modification of land forms, 3) increased visual impact, 4) complete removal of vegetation and alteration in big game movements and 5) relocation of portions of streams.

6. ALTERNATIVES TO TRANSPORTATION

Mine-Mouth Power Generation

Rather than shipping coal great distances to midwestern and southern markets, it would be possible to build a stream generated electrical power plant at the Colowyo Mine site. A local market would have to be developed to utilize this power. Transportation and fuel costs for on-site electric power generation would be minimal and there would be less chance for coal spilling than during transportation to distant power generation plants. However, a coal-burning electrical power generation plant would have to be constructed, transmission lines built, and the generating plant connected into the existing power distribution network. Large volumes of water (up to 17 acre-feet per megawatt of capacity annually) would have to be obtained and pipelines and storage facilities built to supply an on-site steam generating plant.

The local environmental impacts that would result from on-site power generation would be 1) degradation of air quality by stack emissions; 2) land-use problems related to ash disposal; 3) noise from the generating station; 4) the large quantity of water needed must be diverted from other uses; 5) degradation of scenery by the generating station, transmission lines, and support facilities; 6) dust related to coal handling, processing, and ash disposal; 7) loss of land used by the generating station and support facilities from other uses; and 8) increased employment and related economic benefits. Impacts associated with mining and reclamation would remain the same.

Gasification

It is feasible to convert coal to various gaseous forms as a substitute for natural gas. Plant operations, including handling and transporting the coal to the process site and converting the coal to gas, will involve large quantities of coal and water. Daily operations for a typical plant require large volumes of water for cooling and for scrubbing gases; perhaps as high as 30 million gallons per day for a plant producing 250 million cubic feet of synthetic gas per day. Surface area requirements for a plant this size would require in excess of 1,000 acres of land. There is insufficient water supply and coal reserves at the Colowyo Mine site to operate a prototype coal gasification plant.

Liquefaction

A synthetic crude oil by-product can also be manufactured from coal by the combination gasification processes with hydrogen addition. All of the volume requirements for water supply and coal reserves are also true for the liquefaction processes. The Colowyo Coal Company leases do not have the necessary quantities of coal or water for a viable liquefaction operation.

7. NON-ENERGY USES FOR THE COAL

Coal is used by the chemical industry in the manufacture of synthetic materials and has been used as a soil conditioner which, when mixed with topsoil, darkens the soil, absorbs heat, and stimulates plant growth. Some types of lignite have been used in oil drilling muds, in water treatment, and in wood

stains. The coal at Colowyo is sub-bituminous and is not suitable for the latter uses but could possibly be used by the chemical and soil conditioner industries depending upon its properties. If coal production were similar, the impacts of mining and reclamation would remain the same and their severities and extents would not be increased. However, non-energy uses of the coal may not be the highest and best use for this energy resource because of its high quality. Since energy resources are in such high demand, non-energy uses should play a secondary role; coal used for these non-energy purposes should be of lower grade.

C. MINING ALTERNATIVES

1. UNDERGROUND MINING

Underground mining of coal would cause less immediate damage to the surface environment than strip mining. However, the primary motivation for underground mining is that it is the most economical way to extract coal when the producing strata is located at great depths. There are many instances where this condition does not exist on the Colowyo site. The relatively shallow overburden of 50 to 100 feet over the X and Y seams and 150 to 200 feet over the A coal seam, precludes underground mining as an economic alternative for the upper seams. Underground mining would not recover as much of the coal seams as will be recovered by surface mining methods and therefore would not be a conservation measure of a valuable energy resource.

Substitution of this method of mining would result in 1) less initial disturbance of the land surface, 2) subsided land surface degraded by numerous depressions and openings; 3) greater costs because underground mining would be more costly than strip mining; 4) a decrease in mine safety as indicated by the fatal accident rates in 1972 of 0.42 per million tons mined underground versus 0.07 fatalities per million tons for strip mining; 5) higher incidence of non-fatal accidents due to roof and coal falls, fires, explosions, and problems related to dust inhalation (black lung); 6) recoverability of reserves is reduced from potential 95 percent by surface mining to 50 percent or less underground because of support pillars left behind and coal left in beds under four or five feet or over eight to ten feet thick.

Economic conditions override shallow underground mining alternatives. The cost of mining coal by surface methods is approximately two to five dollars/ton, whereas underground mining generally costs six to ten dollars per ton. The difference is due primarily to labor costs as the rate of coal production, expressed per man hour, is also much greater for surface mining

than underground mining, although surface mining capital investments costs are much greater for equipment than for underground mining. Surface mining operations frequently produce more than ten times as much coal per man compared to underground mining. The strip mines in the Yampa area, for example, 35 miles east of the proposed Colowyo Mine, produced at a rate of about 45 tons per man day. Major underground mines in the Gunnison and Trinidad areas had a production rate of around four to seven tons per man-day in 1973.

Typical underground mining operations remove 50 percent or less of the total recoverable coal whereas surface operations are able to remove approximately 90 to 95 percent of the recoverable coal. In the Red Wing Mine underground operations, only about 35 to 50 percent of the total coal was recovered. In contrast, the proposed surface mine should recover at least 90 percent of the coal.

2. CONTOUR STRIP MINING AND AUGER MINING

Contour strip mining along the bottom coal bed outcrop contour line, followed by auger mining, would result in a substantial reduction of land surface removal. However, reclamation problems with the exposed highwall are encountered after the mining of a single stripping cut through the maximum possible thickness of overburden. This is due to the unstable condition of the highwall, created by subsequent auger mining. The probability of uncontrolled caving and accidents is high. Subsidence of surface can be expected after mining. Steep slopes and unstable highwalls are probable.

Since auger mining cannot extend further than 400 to 600 feet into the highwall, all of the coal beyond would be left untouched. Also, only about 30 percent recovery of coal would be realized from that portion mined by augering methods, and thus this mining alternative would seem extremely wasteful.

Economic techniques for extraction of insoluble solids such as coal by in-place mining have not been developed. In-situ burning of coal and capture of the volatile gases released is being conducted on an experimental basis. Should this process ever become feasible, the energy recovery levels and amount of surface subsidence that may occur would still be highly unpredictable.

3. IN-SITU COAL COMBUSTION

In-situ burning of coal is, at present, an experimental process

which involves the fracturing of coal underground and igniting it in order to produce clean burning gas which is collected from boreholes drilled into the coal seams. Care must be taken to prevent leaks to the surface which would reduce gas output appreciably.

Impacts associated with in-situ mining could include the destruction and pollution of ground water aquifers. With the thin overburden associated with coal at the Colowyo leases, air pollution could be expected from the escaping gases, and subsidence and destruction of surface values would probably occur. There would be disturbance of the surface due to the construction of facilities built to process the gas produced. The generated fuel would be low in sulfur because the sulfur produced would be in the form of hydrogen sulfide which could be removed by hot carbonate scrubbers.

D. SUBSTITUTION OF ALTERNATIVE SOURCES OF ENERGY

If the proposed mining plan were rejected and the company could not supply coal to customers, alternate sources of energy would have to be developed somewhere else to supply the power plants.

Other energy sources that may be practical in the future are in various stages of research and development. These sources include nuclear fusion, breeder reactors, geothermal generating plants, magneto-hydrodynamics (MHD), fuel cells and solar energy. Current licensing, insufficient research funds and technological limitations on equipment and materials impose major difficulties. However, none of these energy sources of the future can be used today to supply fuel to existing plants that can burn coal.

The development of conventional nuclear power plants in the United States has been slowed by various problems related to licensing, especially questions regarding safety and environmental impacts. For example, identical nuclear power plants built in Japan took 5 years and more than 8 years in the United States (Joint Committee on Atomic Energy, 1973).

The first large-scale breeder reactor (a prototype for electricity generation) is not expected to be "on line" in Tennessee until 1980 (Popular Science, 1973). Controlled thermonuclear reactions have been suggested as the ultimate power source. However, "During 1971, the world's leading fusion experts... agreed, on the basis of the then current thermonuclear knowledge, that it would probably be around the year 2000 before economic fusion power could be demonstrated" (U.S. Atomic Energy Commission, 1972). Fusion power is not expected to have a significant impact on electrical power production until the year 2020 (U.S. A.E.C., 1973). Accordingly, these alternate

energy sources are not considered viable alternatives. It has also been stated that the U.S. has passed its peak of productivity of oil and gas and is already dependent on energy resources outside the country. However, this energy shortage is expected to be partially offset by conversion of coal into electrical power (Earth Science Bulletin, 1972).

E. NO ACTION ALTERNATIVE (REJECT THE MINING PLAN)

Rejection of the mining plan would result in no environmental impact on the leased lands and they would continue in their present condition modified by the surface owner to meet other uses as may be determined. The lessee could submit a new mining plan, challenge the rejection, or abandon -- a least temporarily -- development of the lease. Should the mining plan be rejected, the development of alternate sources of energy or a reduction of energy consumption could be required.

If energy demands are to be supplied by coal, suspending development of federal coal at the Colowyo Mine site will shift impacts to other coal regions. Utilizing coal from another area such as the midwest would create some impacts in those areas similar to those which occur in the study area if coal development is allowed. New mines would need to be opened or production expanded at existing mines. Since most of the midwest coal is mined underground, recovery would be less than 65 percent compared to the 95 percent projected for the study area. Additional transportation systems would be required in the midwest and since these areas are more heavily populated, construction of new or expanded transportation facilities could have an impact of greater magnitude than within the study area. Since much of the eastern coal is of higher sulfur content, the resulting air pollution will be worse upon utilization of that coal.

A summary of the impacts of "no action" on the Colowyo Coal Company leases near Axial, Colorado would be as follows: A) Electrical generating stations in the midwest or south would have to find another source of low sulfur coal capable of meeting air emission requirements; B) Revenue to Federal, State and local governments would not develop; C) Traffic to Craig and Meeker would be reduced; D) Adverse impacts on landform, geology, soils, etc. would not occur; E) One of the few surface mineable coal deposits in the region would not be utilized; F) Loss of wildlife habitat and grazing area would not occur; G) Use of groundwater, electricity and fuel oils would not occur; H) Aesthetic impacts, including dust and noise, would not occur; I) Alterations in groundwater flow and water quality would not occur; J) Impacts on housing schools, public utilities, community facilities, and community development would not occur.

RELATIONSHIP BETWEEN LOCAL SHORT TERM USES OF MAN'S ENVIRONMENT AND THE MAINT. AND ENHANCEMENT OF LONG TERM PRODUCTIVITY

IX. THE RELATIONSHIP BETWEEN SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

In earlier discussions (see Section V), it was pointed out that the majority of the environmental impacts would be of a short-term nature. In terms of productivity, the extraction of coal from the Colowyo Mine will enhance the economics of the region over its present basic agriculture nature. Since the surface mine will only have a life of some 15 years, the removal of 2,500 acres of ranch land from active production will be the short-term effect on the region. Proper reclamation practices with an understanding of the successional characteristics to the ecosystems assures return of the land to a productive state. After surface mining is completed, the combined agricultural developments (grazing and/or farming) and the proposed underground mining will assure a combined long-term economic base for the region.

In the case of wilderness characteristics, however, the estimates of productivity versus environmental quality are difficult to assess. Wilderness can only be measured as a feeling which produces a different response in every person. Once the feeling of remoteness, isolation, solitude, or whatever adjectives one wishes to use, is removed from the landscape, it is virtually impossible to replace. As the pressures of contemporary society become more and more oppressive, the existence of open spaces where man's impact is slight takes on an increasingly important meaning. The primary purpose then in the production of environmental development plans as the comprehensive assessment of economic needs on the one hand versus sociopolitical-ecological needs on the other. Thus out of necessity, any wise development decision requires the availability of a wide variety of area specific information.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

X. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Considered by itself, the proposed coal mine will commit only the land upon which it is placed and the materials required for construction and operation. As the project moves toward completion however, the loss of coal as a resource will be irretrievable.

Secondary commitments of time, money, and energy will also develop out of necessity during the mining operations. Since people will be employed to operate the mine, land, water, various building facilities, and electrical power resources will be needed. These commitments will last only the life of the project.

Peripheral developments or resource consumption will become increasingly important in the decision-making process, however. Since coal resources, and especially those containing low percentages of sulfur, will probably supply increasingly large amounts of energy to meet American needs, the effects of these developments on areas far removed from the mines will have to be considered. Legal battles are presently developing which will consider this question of long distance imports and resource consumption. Many recent editorials in Colorado newspapers, for instance, question the legality and wiseness of potential environmental deterioration in the Rocky Mountain region to foster unplanned or continued sprawl type growth in another. Clear answers or solutions have not as yet been given to this argument of energy needs versus open space resources and will most likely constitute a considerable portion of the debate surrounding proposed western energy developments.

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APPENDICES

APPENDIX A.

APPENDIX A - PART I

REVEGETATION

LOCAL EFFORTS AND RESEARCH

In terms of strip mining, Colorado has not had the intense activity of other coal regions. No established revegetation research has been attempted at the existing Colowyo Mine. However, field reconnaissance showed a number of species (see photographs) were successfully invading the spoil dumps (see Section IV). Vegetation research at the Seneca Mine at Hayden (Berg, W., and E. Barraw, 1973) has been underway since 1965. The findings of this study can be applied to the Taylor Creek Mine site since similar conditions exist. Table A-1 represents the species seeded, species frequency, and relative productivity of plants tested on coal spoils from the Seneca Mine. Generally, plant establishment and productivity were good. Alfalfa proved to be the most successful species, though it required warning and may not be adequate for the Colowyo project.

Results also showed that the greatest difference between the spoils and the soils was that the spoils were quite low in total nitrogens. The success on the alfalfa on these spoils, then, may be due to the fact that this plant has the ability of fixing nitrogen through bacteria in the nodules on the roots. This is an important factor where nitrogen is limiting to plant establishment success was achieved on the more coarsely textured spoils. Since plant-soil moisture relations are more favorable on coarser textured soils than on finer ones, it should be expected that the spoils would make an adequate seedbed. It must be emphasized, however, that the relatively favorable pH of the spoils (approximately pH 8) was an important factor in all the findings. The pH values show high correlation with the availability or nonavailability of various important and also deleterious minerals for plant growth.

Reclamation Research

The literature of surface mining reclamation programs and the results of those programs is extensive. Two recent reports (i.c., Research and Applied Technology Symposium on Mined-Land Reclamation, March 1973; The Revegetation of Areas Disturbed by Surface Mining Activities, November 1972) outline some of the numerous considerations of planning, design, and experimentation required to develop optimal methods, applicable to each

TABLE A-1

SPECIES SEEDED, SPECIES FREQUENCY, AND RELATIVE PRODUCTIVITY ON SENECA SPOILS

	Pounds Seeded on Seneca Spoils[1]				1970 Sampling	
Species	**1965**	**1966**	**1967**	**1968**	**% Frequency[2]**	**% of Total Herb. Prod.**
Alfalfa (Cody)	0	0	360	476)	78.5	79.0
Alfalfa (Rhizoma)	210	36	80	357)		
Sweet Clover	140	24	180	238	23.5	7.0
Alsike Clover	140	36	0	0	0.0	0.0
Smooth Brome	280	48	360	476	31.5	6.0
Timothy	210	0	0	119	5.0	0.2
Crested Wheatgrass	0	0	180	238	19.0	1.0
Intermediate Wheatgrass	350	60	360	238)	15.0	2.4
Pubescent Wheatgrass	280	48	180	238)		
Orchardgrass	0	0	90	0	16.5	3.0
Tall Fescue	0	0	90	238	10.5	0.3
Hard Fescue (Durar)	70	12	0	0	0.5	T[3]
Cheatgrass	Not Seeded				2.0	0.3
Russian Thistle	Not Seeded				2.0	T
Other Annual Weeds	Not Seeded				2.0	T
Canada Thistle	Not Seeded				1.5	T
Big Sage	Not Seeded				0.5	T

[1] Information supplied by A.F. Grandt, Peabody Coal Co. This total amount of seed was applied to approximately 290 acres. Our transects may or may not have crossed areas seeded each year.

[2] Percent of the time this species occurred within the 1/2 m^2 sampling area.

[3] T = Trace.

Source: W.A. Berg and E.M. Barrau Composition & Production of Seedlings on Stripmine Spoils in northwestern Colorado. Paper presented before Research & Applied Technology Symposium on Mine Land Reclamation, March 7-8, 1973, Pittsburgh, Penn.

unique situation, which will improve the quality of the overall land reclamation effort. These considerations closely parallel the concept of the environmental impact statement (EIS). Simply stated, the EIS requires a detailed analysis of the existing environment, the proposed project and the impacts, mitigation measures, and alternatives to the project. In particular, planning and preliminary analysis of overburden, topsoil, climate, itc., should lead to experimentation and knowledge regarding the following: optional combinations of soil treatments (fertilization, top-soiling, watering and mulching); optimal combinations of introduced and native grasses, forbs, shrubs amd trees; and optimal methods of spoil preparations, including grading, weathering, contouring, etc.

The Montana Agricultural Experiment Station, Montana State University Animal and Range Sciences Department has been one of the leading institutions researching strip mine revegetation. Their work has broad application for the entire Rocky Mountain Region. Their studies document the effects on revegetation rates and densities, of variables such as surface manipulations, soils media, topsoiling depth and gradient, fertilizer, plant species, etc. As part of the evaluation process, they also contain data on overburden and topsoil analysis and water quality. A detailed summary of the numerous studies and results is beyond the scope of this report.

However, two studies are especially interesting and relevent. They concern (1) evaluating the development of plant species and communities in terms of successional characteristics and (2) comparisons between long-term and short-term revegetation capability of introduced and native species. Both studies have only begun; consequently, any interpretations are only tentative and long-range conclusions are inappropriate.

The Plant Community Development Study (Montana State University) began in the spring of 1972 at the Rosebud Mine at Colstrip, Montana, operated by Western Energy Company. Approximately 10 acres of raw spoil were shaped and covered with 6 to 8 inches of topsoil. After site preparation, a broad mixture of annual and perennial grasses, shrubs, and legumes was seeded. Plant establishment was rapid and the site was stabilized and erosion prevented. The major plant productivity in the first year was due to the annuals; however, after the annuals die, surviving perennials are expected to become established. More recently, research has begun into the feasibility of using shrubs in the revegetation process. This approach may prove extremely important in improving the range-carrying capability of the reclaimed land. It is also possible that careful analysis of the plant community development on this site will permit comparisons with future possible studies of natural succession on old disturbed areas. These comparisons may permit design of mining

reclamation plans which will increase the rate of succession toward a climax community.

The second study, conducted by personnel of the Forest Service working under the SEAM Program, U. S. Department of Agriculture, Intermountain Forest and Range Experiment Station, Logan, Utah, began in the fall of 1972 on natural subsoil three feet below the surface at the Decker Coal Mine, Decker, Montana. Three plots, each containing 48 subsections, were carefully laid out. The plots were seeded with either native species only, introduced species only, or a combination of native and introduced species. The effect of topsoiling will be evaluated by comparing a topsoil block with a control block. The 48 subsections are used to vary combinations of grass species, mulching, and fertilization. The selection of grass seeds was based upon an extensive study of the literature, analysis of soil characteristics, determination of climatic conditions, temperatures and incident radiation, and observations and experience of personnel. The plants were selected on the basis of adaptability to the existing conditions. Continued observation and analysis of these plots may lead to an optimal choice of plant species and soil treatments to maximize land reclamation.

APPENDIX A - PART II

MINING PLAN FORMAT

The U.S. Geological Survey has issued the following format for the preparation of a mining plan with the statement that the Mining Supervisor may require that the mining plan include any or all of the following: (The major sections of this report pertaining to non-asterik items are given)

Note: The asterik indicates items necessary only on modified or revised mine plans for underground mining.

I. WRITTEN STATEMENT ON THE FOLLOWING:

A. Nature and occurrence of deposit. See Sections I, II & III of this report.
   1. A description of the location and area to be affected by the operations (pages 9 and 30 to 125).
   2. General geology (pages 30-42).
   3. Roof and floor rock (pages 30-42).
   4. Overlying and underlying coal beds (see Figure 5).

*B. A description of measures to be taken to prevent or control fire, soil erosion, pollution of surface and ground water, pollution of air, damage to fish and wildlife or other natural resources, and hazards to public health and safety. See Section III-D, and Section VI.

*C. Development and mining plans. See Section III for surface mining plan.
   *1. A statement of proposed methods of operating, including a description of the surface or underground mining methods, the proposed roads or vehicular trails, the size and location of structures and facilities to be built.
   *2. A statement of reason for not mining full thickness if only part of a bed is to be mined.
   *3. A statement of reason why a particular bed is to be mined first if multiple seams are present.
   *4. Refuse and spoil disposal procedures.
   *5. Pollution control (dust, air, water, noise, etc.) An estimate of the quantity of water to be used and pollutants that are expected to enter any receiving waters.

D. Safety. See Section III-E.
   1. General safety plan and organization to include in part:
      *a. Underground Mining (roof control, ventilation, haulage, etc.)

    b. Strip Mining (haulage, pit, drainage, highwall, sloping, etc.) (Pages 22-25).

E. Surface restoration. See Section III-E.
1. Topsoil removal and disposition (Note: Topsoil storage and redistribution will be required in most operations) (See pages 28-30).
2. Grading and backfilling (See pages 12-21 and Figures 16 and 30).
3. Erosion controls and pollution (See page 29 and appropriate sections throughout report)
   A design for the necessary impoundment, treatment or control of all runoff water and drainage from workings so as to reduce soil erosion and sedimentation and to prevent the pollution of receiving waters, also quality of water (See page 27).
4. Restoration and planting (See III-E, page 28).
   a. If the permit or lease requires regrading and backfilling, the exploration or mining plan shall show the proposed methods and the time of grading and backfilling of areas of lands affected by the operations. (See Figure 5)
   b. Revegetation, regrading, backfilling - In those instances in which the permit or lease requires the revegetation of an area to be affected by operations, the exploration or mining plan shall show:
      (1) Proposed methods of preparation and fertilizing the soil prior to replanting.
      (2) Types and mixtures of shrubs, trees, or tree seedlings, grasses or legumes to be planted.
      (3) Types and methods of planting, including the amount of grasses or legumes per acre, or the number and spacing of trees, or tree seedlings, or the combinations of grasses and trees.

   Items listed are not finalized at present; however, see Appendix A for further details.

II. MAPS

A. Surface strip mining map(s) shall show: Section III
1. General topography and existing and proposed improvements, roads, refuse, strip pits, spoil piles, pit drainage, coal storage, surface structures existing and proposed, etc. (Figures 7, 8 and 9).
2. Cross section showing coal thickness and overlying and underlying coal beds (See Figure 5).
3. Planned sequence of mining by numbers or by the year.

4. Location of planned roads, buildings, and other improvements (See Figure 7).
5. Erosion control structures (See Appendix D).

*B. Surface map(s) for underground mine operations shall show:
1. General topography and existing improvements
*2. Location of planned roads, buildings, other improvements, waste disposal, coal storage, drill holes, mine portals, etc.
*3. Erosion control and structures

Above items not applicable for this report

C. Underground mine operations plan map shall show:
*1. Widths of entries and rooms and center line distances
*2. Size of barrier pillars to be left in place
*3. Width and length of panels
*4. Bleeder systems
*5. Method of mining including ventilation, pillar extraction, haulage, etc.
*6. Planned sequence of mining by number or by the year
*7. Overburden isopach lines on 500 ft. intervals
*8. Dip and strike of coal bed
*9. Cross sections to show the following:
  *a. Total thickness of the coal bed and thickness to be mined
  *b. Roof and floor rock
  *c. Overlying and underlying coal beds, show thicknesses and intervals
  *d. Coal quality

Above items not applicable for this report.

D. Abandonment. Not formalized at present-projected surface mine development is scheduled to last 20 years.
1. Method to be used (sealing of portals, sloping of spoil, etc.)
2. Removal of surface structures and cleaning up area after mining.
3. How waste and spoil dumps will be reclaimed to prevent public hazards and degradation of the lands and waters.

A mine plan must be submitted in quintuplicate where surface lands are disturbed and in triplicate for underground mine plans for the approval of this office in advance of operations. Mine plans, including mining sequence, must be followed unless approval for change of plans is granted by the Mining Supervisor.

NOTE: The plan must include several cross-sections to show the initial profile of the land, mining profile and profile after mining.

J. Paul Storrs
Area Mining Supervisor
U.S. Geological Survey

APPENDIX B.

APPENDIX B

W. R. Grace Colowyo Mine Property

Species List

The following are lists of the plants and animals observed or expected to occur on the W. R. Grace Colowyo mine property in Moffat County Colorado. The sources of these lists are field surveys by VTN biologists, published and unpublished species lists of the general area and consultation with local officials. These lists are not intended to be exhaustive, but are meant to give a clear understanding of the nature and diversity of the biological resources of the area.

Vegetation

Trees

Aspen	Populus tremuloides
narrowleaf Cottonwood	Populus angustifolia
Utah juniper	Juniperus osteosperma
	Pinus edulis

Shrubs

Utah serviceberry	Amelanchier utahensis
Gambel (scrub) oak	Quercus gambelii
snowberry	Symphoricarpos oreophilus
willow	Salix sp.
big sagebrush	Artemisia tridentata
Oregon grape	Berberis repens
wild rose	Rosa woodsii

Herbs (species in bloom or otherwise identifiable May 6, 1974)

violet	Viola purpurea
buttercup	Ranunculus glaberrimus
American bluebells	Mertensia lanceolata
Rocky Mountain loco	Oxytropis sericea
paintbrush	Castilleja integra
groundsel	Senecio eremophilus
yarrow	Achillea lanulosa
false yarrow	Chaenactis sp.
clover	Trifolium sp.
lupine	Lupinus sp.
death camus	Zigadenus sp.

Wild onion	Allium sp.
blue-eyed mary	Collinsia sp.
phlox	Phlox sp.
catttail	Typha latifolia
sedge	Carex sp.
rush	Juncus sp.
Indian ricegrass	Oryzopsis hymenoides
wild rye	Elymus cinereus
six weeks fescue	Festuca octoflora
prickly pear	Opuntia polyacantha

Wildlife (species observed or tracked on property are indicated with an asterisk, others are likely to occur in the area).

Mammals

*elk	Cervis canadensis
*mule deer	Odocoileus hemionus
*coyote	Canis latrans
*yellowbelly marmot	Marmota flaviventris
*golden-mantled squirrel	Spermophilus lateralis
*northern pocket gopher	Thomomys talpoides
*blacktail jackrabbit	Lepus californicus
desert cottontail	Sylvilagus auduboni
bobcat	Lynx rufus
striped skunk	Mephitis mephitis
rock squirrel	Spermophilus variegatus
lone-tailed weasel	Mustela frenata
long-tailed vole	Microtus longicaudus
deer mouse	Peromyscus maniculatus
least chipmunk	Eutamias minimus
Ord's kangaroo rat	Dipodomys ordii

Birds

*turkey vulture	Cathartes aura
*red-tailed hawk	Buteo jamaicensis
*rough-legged hawk	Buteo lagopus
*marsh hawk	Circus cyaneus
sparrow hawk	Falco sparverius
golden eagle	Aguila chrysaetos
great horned owl	Bubo virginianus
barn owl	Tyto alba
*black-billed magpie	Pica pica
*mallard	Anas platy rhynchos
common raven	Corvas corax
*common crow	Corvus brachyrhynchos
*rufous-sided towhee	Pipilo erythrophthalmus

*green-tailed towhee	Chlorura chlorura
*robin	Turdus migratorius
*chipping sparrow	Spizella passerina
Oregon junco	Junco oreganus
mourning dove	Zenaidura macroura
western meadowlark	Sturnella neglecta
red-winged blackbird	Agelaius phoeniceus
horned lark	Eremophila alpestris
mountain bluebird	Sialia currucoides
sage grouse	Centrocercus urophasianus
sharp-tailed grouse	Pediocetes phasianellus
chuckar	Alectoris graeca
black-chinned hummingbird	Archilochus alexandri

Reptiles and Amphibians

eastern fence lizard	Sceloporus undulatus
sagebrush lizard	Sceloporus graciosus
tree lizard	Urosaurus ornatus
side-blotched lizard	Uta stansburiana
collared lizard	Crotaphytus collaris
plateau whiptail	Cnemidophorus velox
short-horned lizard	Phrynosoma douglassi
western garter snake	Thamnophis elegans
gopher snake	Pituophis melanoleucus
racer	Coluber constrictor
western rattlesnake	Crotalus viridis
woodhouse's toad	Bufo woodhousei
Great Basin spadefoot	Scaphiopus intermontanus
*tiger salamander	Ambystoma tigrinum

APPENDIX C.

THE STATE HISTORICAL SOCIETY OF COLORADO
Colorado State Museum, 200 Fourteenth Avenue, Denver 80203

March 26, 1974

To Whom It May Concern:

Compliance with the Federal Antiquities Act of 1906, the National Historic Preservation Act of 1966, the National Environmental Protection Act, and the Executive Order 11593 requires an *in situ* survey of all leased Federal lands to locate, salvage, study and preserve the cultural resources located thereon prior to the development of those lands.

Sincerely,

James J Hester

James J. Hester
Acting State Archaeologist

RECEIVED JUN - 3 197

UNIVERSITY OF COLORADO

ARCHAEOLOGICAL RESEARCH CENTER
PO Box 67
MESA VERDE NATIONAL PARK

COLORADO 81330

30 May 1974

Christopher B. Caliendo
VTN Colorado
6875 East Evans
Denver, Colorado 80222

Dear Chris:

I finally borrowed a typewriter in order to get off the report of our reconnaissaince of the proposed coal stripping area in the Axial Basin.

With two doctoral canidates from the Department of Anthropology, we traversed as much of the designated area as was possible due to road conditions, time, and weather. This was done on Memorial Day, 27 May 1974.

Our total collected archaeological sample consists of one reddish quartzite chip (flake) from just above the stock tank in the NW¼ of the NW¼ of Section 9.

Counting travel time, I am certain that two people (NOT myself) could adequately "survey" the remainder of the tract in a total of 3-days. However, it is my opinion that nothing of archaeological significance will be found in this particular area.

Correspond with me at the above address during the summer. If you wish to phone me, I will be at this phone number (303-529-4401) on Saturdays and Mondays. I will not be here during the week.

Sincerely,

David A. Breternitz

David A. Breternitz
Director, Mesa Verde
Research Center

APPENDIX D.

APPENDIX D

AIR AND WATER RESOURCES BASELINE MONITORING PROGRAM

In June, 1974, the Water Resources Division, Colorado District of the United States Geological Survey (USGS), began a one-year program to study the water resources and water quality of both surface and subsurface waters at the Colowyo Coal Company site near Axial, Colorado. This water element represents a portion of a joint study being conducted by the Bureau of Reclamation and the USGS to assess the reclamation potential of the Colowyo mining site. Details of this year-long program are itemized below as they were taken from a USGS letter dated June 7, 1974 directed to Mr. Douglas M. Ross, Director of Environmental Sciences, VTN Colorado, Inc., from John F. Ficke of the Water Resources Division, Colorado District.

> Surface water.--Studies of surface water are to document the amount and quality of water in the streams, and to predict what these amounts and qualities will be after mining. Elements of the work are listed below:
>
>> Conduct a reconnaissance early in the 1975 FY of water quality of streams in the tract area, sampling at selected sites for inorganics, organics, and trace metals, measuring specific conductance and pH, and examining stream fauna.
>>
>> Estimate annual runoff of streams draining the tract by channel geometry methods.
>>
>> Conduct a low-flow reconnaissance of streamflow late in the summer of 1974.
>>
>> Use established rainfall-runoff modeling techniques to estimate peak runoffs at various intervals based on areal precipitation records.
>>
>> Sample water quality and sediment discharge at 8 sites, 4 times per year, with about 1/4 of the samples analyzed for organics and trace metals.
>
> Ground water.--Work on ground water will be directed toward finding out how much water is available and suitable for use on the tract, and will still be available after the mining operation is completed. The principal study will center around a deep exploratory hole to be drilled toward the north end of the tract near one of the

Grace Company core holes, so that the core hole will serve as an observation well. Activities include:

Drill deep hole to estimated depth of 600 feet, using air-rotary or cable-tool method, make geophysical logs, and pack and pump test for each layer of aquifer.

Drill and case about 4 alluvial wells along streams draining the tract.

Case about 4 selected Grace Co. core holes to use as observation wells to determine annual variations in water levels.

Monitor water levels with monthly measurements in about 10 Grace core holes.

Analyze samples collected from different aquifers during pump testing.

Additional Work.--Other activities of the project include:

Install, operate, and analyze the record from a recording precipitation gage.

Interpret data and prepare report.

We have tentative approval of the plan from our regional office, however, final approval will be contingent upon signing of the Department of Interior Appropriation Bill, and upon agreement by the Bureau of Land Management. I do not expect any changes.

In addition to the data collection program proposed by the USGS, the Colowyo Coal Company will augment that program by installing a variety of air quality, water quality and stream gaging stations to establish baseline conditions prior to the initiation of mining activities and to monitor these same elements after mining operations have commenced. These stations are located on a map (Figure D-1) which follows this description. Installation and calibration of this equipment will be undertaken prior to November 1, 1974. It is the intent of the Colowyo Coal Company to negotiate a contract through the State Engineer's office of Colorado to enlist a cooperative program with the USGS to operate and maintain the water stations and the recording precipitation gage. In this cooperative program, the Colowyo Coal Company would construct the stations and install the required equipment to meet USGS standards and specifications. Stations will be specifically

located under the direction of the USGS adjacent to highways or roads which can be accessed during periods of adverse weather. Upon completion of these stations, the USGS would assume the responsibility for operation, maintenance, data acquisition and publication of records from these stations. The general scope of the Colowyo Coal Company monitoring plan is discussed under the appropriate sections that follow.

Meteorological Station: One meteorological station will be located on the Colowyo mine site at a suitable location to gather the following data:

- Wind direction
- Wind velocity
- Temperature
- Precipitation

All data will be recorded on continuous monitoring equipment which will record readings on strip charts or on digital punched tape.

Stream Gaging Stations: Water stage recording stations will be installed on Good Springs Creek and Wilson Creek. Both stations will be positioned downstream from the proposed Colowyo mining operations. The station on Wilson Creek will be located at the confluence of Milk Creek as shown on Figure D-1. Both stations will be equipped with bubble gages and digital punch recorders.

Water Quality Monitoring Stations: Continuous water quality monitoring stations will be installed at the sites of the two water stage gaging stations on Wilson Creek and Good Springs Creek. Parameters that will be measured on a continuous basis are temperature and conductivity. Grab samples will be taken once a month for selected inorganics, organics, pH, trace elements, dissolved oxygen, suspended solids and total dissolved solids.

Ground Water Monitoring Program: Water samples will be pumped from the four alluvial wells and the four deeper observation wells for water quality analyses. These eight wells are the same ones that were delineated by the USGS as part of their observation well network which will be established on the Colowyo mine site. These wells would be sampled twice a year for the same constituents as established for the surface water quality monitoring program which was set up by the USGS.

APPENDIX E.

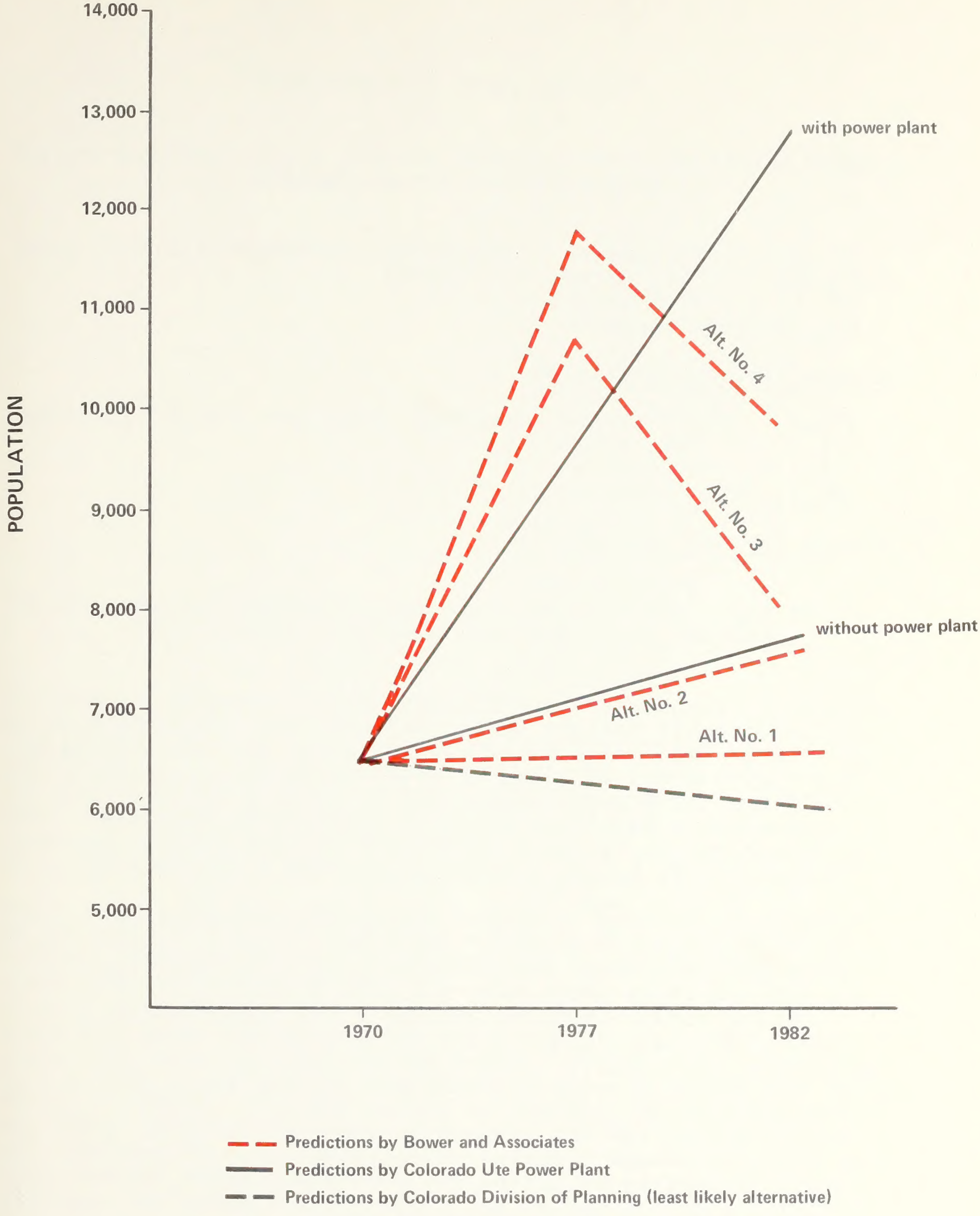
APPENDIX E - PART I

POPULATION PATTERNS AND PROJECTIONS FOR MOFFAT, RIO BLANCO AND ROUTT COUNTIES

Several studies involving projections for growth have been developed for the tri-county area. Reports prepared by various consultants are discussed in this section as well as changes in the economic and social milieu since some of these projections were formulated.

Moffat County: For the Moffat County area and the Colorado West Area Council of Governments, James Bower and Associates compiled the "Moffat County Impact Analysis" in January, 1974. The report analyzes four alternatives for growth in the County which are: 1) No new development of coal resulting in a steady-state situation; 2) Small increase in coal development causing growth by 1982 to 7,600-7,900 people. This, therefore, would mean an increase of 1,000-1,400 people in the next few years; 3) Additional coal production and the addition of a power plant would bring the population to 11,000 in 1977 with a decline to 8,000 by 1982 due to construction workers; 4) Further increases in coal development would boost the population to 12,000 by 1977 dropping off to 11,000 by 1982, also related to construction activities. (See Figure E-1.) According to communication with Mr. Bower, the first two are a remote possibility.

The Colorado-Ute Power Association presented a population growth study for their Yampa project which has been presented to the Craig-Moffat County Planning Commission. The Business Research Division of the University of Colorado at Boulder sponsored David Monarchi who projected both project and non-project related cumulative growth. The results of his study following. His figures are considered low both by Colorado-Ute Power Association and by the researcher himself. The report predicts a 90 percent increase in population, or a total of 13,000 persons by 1982 when the plant is built. It is further estimated that since construction workers would be absorbed by other resources development, the loss of population from construction workers would be small.



vtn

FUTURE GROWTH PATTERNS
Moffat County

SOURCE: PREPARED BY VTN

FIGURE E-1

COLORADO-UTE YAMPA PROJECT

Population Projections for the Entire Project Including Utah International's Oak Ridge Mine

Craig District Population (present)	January 1973	6,750
(peak)	March 1977	13,300
	March 1979	11,700
	December 1982	13,000

90 percent overall growth

Employment Growth for Craig District	January 1973	3,000
	March 1977	6,300
	March 1979	5,200
	December 1982	5,700

110 percent overall growth

Source: David Monarchi's report to Colorado-Ute cited by Mrs. Cansgen, Colorado Ute, Montrose, Colorado

The General Manager of Colorado Ute has stated publicly that these figures are low--how low is the subject of speculation. Considering the new leases, lease applications and permits for exploration, growth of the coal industry is inevitable. Adding the Colorado-Ute figures to the conservative Bower and Associates figures of alternative D, which predicted a fourfold increase in coal mining, projects a total of 17,600 people in 1977 and projects a decline in 1982 to around 16,480 people.

Bower and Associates population estimates were compiled prior to the energy crisis. The predictions of 1,158,000 short tons of coal per year for the county can now be easily changed to 3,000,000 short tons of coal per mine site, given present coal company applications and a revised national energy policy. Since the Bower and Associates study, twenty new coal lease areas have been proposed by the Bureau of Land Management (BLM) and will be acted upon by mid-summer according to the BLM Craig District office. The BLM itself is bringing 40 new employees and their families to Craig by August, another indication of the pressure to fully develop the region's resources. The fact that several energy companies are buying property near Craig and that the Lower Yampa project may be decided upon within five years, are factors which will influence growth trends.

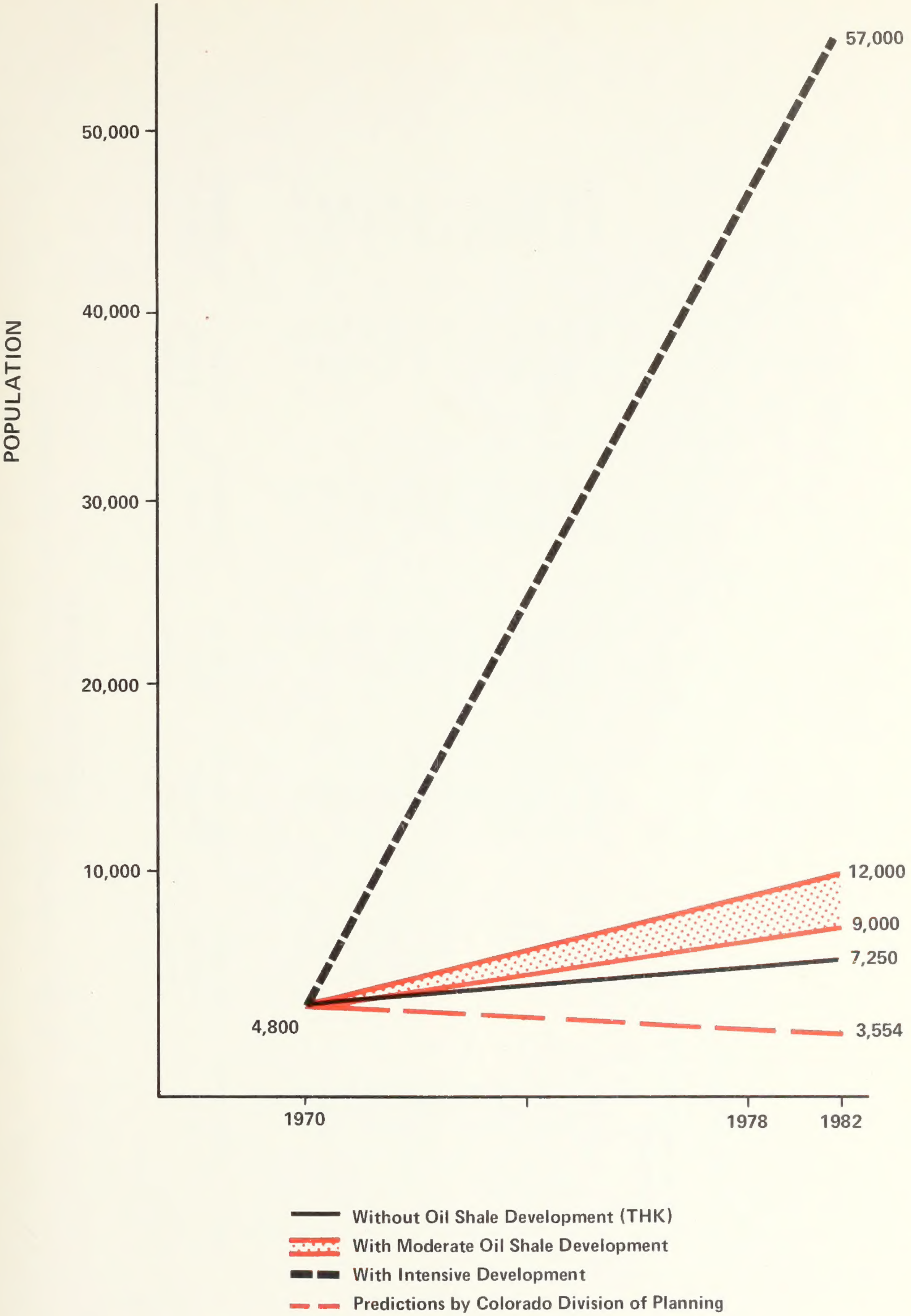
The City of Craig and Moffat County will feel additional growth pressures which have not yet been taken into account in population projections resulting from possible railroad or pipelines

employees. The development of oil shale lands in adjacent counties will increase the likelihood of "spill over" population growth into the tri-county planning region.

Rio Blanco County: Rio Blanco County has been analyzed with regard to the development patterns related to an oil shale industry by a consulting team comprised of the Denver Research Institute, THK and Associates, and Bickert, Browne, Coddington and Associates. The report, prepared for the Oil Shale Regional Planning Commission and Colorado West Area Council of Governments (CWACOG), estimates county trends for Mesa, Garfield and Rio Blanco Counties for no development, moderate, and for intensive oil shale development. Without oil shale development, the population would probably grow three percent until 1978 when the "snowballing" effect of growth would probably increase the rate to five percent (CWACOG, 1974). This pattern as far as Rio Blanco County is concerned could be the same with moderate development of oil shale as well. With moderate or intensive development, two patterns occur: 1) 60,000 newcomers to the oil shale region over the next 15 years, perhaps an erratic rate due to fewer plants than with 2) intensive development which could bring 160,000 new people, including plant construction, mining and processing and local service employment. The intensive profile is based upon a million-barrel-a-day oil shale industry with three-quarters of the oil shale resources coming from Colorado.

Although not broken down by county, several assumptions can be made for Rio Blanco County. Intensive development is dependent upon the extraction and processing of oil shale from the two proposed federal leases located in Rio Blanco County and the proposed federal lease in Utah located near Rangely, Colorado. It is also dependent upon the development of private lands in Garfield County. If intensive development occurs, Rio Blanco County will probably receive a tremendous increase in population during the 15-year period. If approximately one-third of the total projected increase comes to Rio Blanco County, which is possible with intensive development, an additional 53,000 to 54,000 people may be living within the county (Tables E-1 and E-2). If moderate development occurs, the impacts on Rio Blanco County will probably be much less, as most of the development will take place on private lands in Garfield County. (See Figure E-2.)

Routt County: Routt County's "Inventory Report of the Comprehensive Plan" was compiled by Charles Gathers and Associates. The population estimates are based upon a high growth potential ski and tourist industry, and upon the ability of the county to accomplish diversification attracting a variety of industries.



FUTURE GROWTH PATTERNS
Rio Blanco County

SOURCE: PREPARED BY VTN

FIGURE E-2

TABLE E-1

POPULATION RESULTING FROM OIL SHALE DEVELOPMENT INTENSIVE PROFILE*

Year	Basic Employment	Basic Income ($1,000)**	Local Service Employment	Local Service Income ($1,000)**	Total Employment	Total Income ($1,000)**	Total Population
0	–						
1	–						
2	450	$ 5,374	50	$ 368	500	$ 5,742	1,250
3	1,650	20,402	850	6,494	2,500	26,896	6,250
4	1,050	13,440	990	7,125	1,950	20,565	4,875
5	2,565	31,474	3,000	24,612	5,565	56,086	13,913
6	2,365	29,755	4,730	40,162	7,095	69,917	17,738
7	5,280	69,324	10,560	92,801	15,740	162,125	39,350
8	7,730	107,825	15,460	140,624	23,190	248,449	57,975
9	8,700	121,717	17,400	163,804	26,100	285,521	65,250
10	10,530	148,901	21,060	205,186	31,590	354,087	78,975
11	12,810	184,988	25,620	258,352	38,430	443,340	96,075
12	16,290	243,708	32,580	340,037	48,870	583,745	122,175
13	18,720	288,048	37,440	404,427	56,160	692,475	140,400
14	21,465	337,493	42,930	479,957	64,395	817,450	160,988

*2.0 multiplier.

**3½% per annum increase in real income.

Source: THK Associates, Inc.

TABLE E-2

POPULATION RESULTING FROM OIL SHALE DEVELOPMENT
MODERATE PROFILE*

Year	Basic Employment	Basic Income ($1,000)**	Local Service Employment	Local Service Income ($1,000)**	Total Employment	Total Income ($1,000)**	Total Population
0	–						
1	–						
2	450	$ 5,374	50	$ 368	500	$ 5,742	1,250
3	1,650	20,402	850	6,494	2,500	85,346	6,250
4	1,050	13,440	900	7,125	1,950	20,565	4,875
5	2,565	31,474	3,000	24,612	5,565	56,086	13,913
6	2,365	29,755	4,730	40,162	7,095	69,917	17,738
7	4,380	56,562	8,760	76,983	13,140	133,545	32,850
8	4,430	59,367	8,860	80,591	13,290	139,958	33,225
9	6,600	89,803	13,200	124,265	19,800	214,068	49,500
10	5,400	74,089	10,800	105,244	16,200	179,333	40,500
11	8,430	119,836	16,860	170,016	25,290	289,852	63,225
12	7,230	103,803	14,460	150,919	21,690	254,722	54,225
13	10,260	153,691	20,520	221,657	30,780	375,348	76,950
14	8,160	121,175	16,320	182,458	24,480	303,633	61,200

*2.0 multiplier.
**3½% per annum increase in real income.

Source: THK Associates, Inc.

Two alternative growth patterns are given. Growth over the past few years shows in 1970 a tourist housing capacity of 2,554 in Routt County with a resident population of 6,600. The total was 9,100, 27 percent a tourist or peak population which usually occurred in the Winter Season or partially in the Summer Season. In 1973, a review of county housing revealed a resident population of around 9,400 with an additional tourist housing capacity of 5,800. The total population of 15,200 persons represents peak capacity of both segments, 38 percent of which is tourist. The total of both grew 67 percent in three years, which is considered a "boom" rate. John Colt of Charles Gathers and Associates based the following projections on historical trends in the ski industry. The expansion of the community of Hayden from mining development was not considered in the projections.

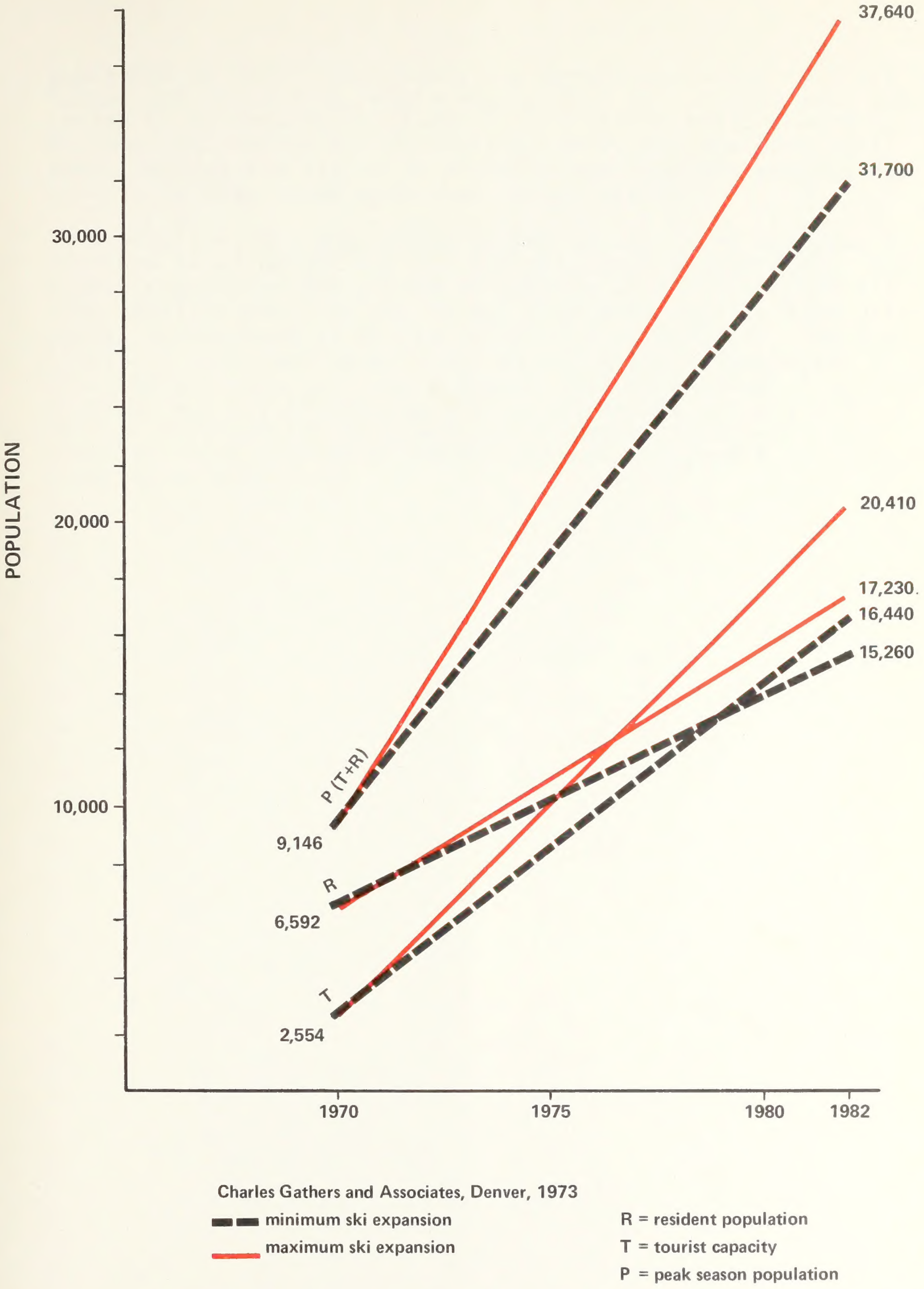
The Inventory report states that between 1973-1995, Routt County's future population trends depend heavily upon economic development and environmental decisions. Depending upon these factors the county's peak total might increase from 15,200 in 1973 to 58,000 in 1995. Or, the county may follow a more moderate course and rise to a population of 39,600 persons in 1995. The moderate course suggests that a population of 39,600 is the maximum number for which housing will be built; the extreme suggests a population of 58,500 persons with 57 percent being short-term residents, or tourists and 25,000 being permanent residents.

Figure E-3 shows alternatives for resident population (R), tourist capacity (T) and tourist and resident season population.

Mr. Colt feels the projections should now be changed to consider 1) possible declines in the recreation industry, i.e., bankruptcy of the Stagecoach area, 2) the rapid expansion of coal mining, 3) attraction of industry to the area combined with need and desire to diversify, 4) citizen desire for moderate growth, a new zoning plan to limit recreational growth and second home development, and continuous environmental research, and 5) the energy crisis influence.

Depending upon the recreation and mining markets, Routt County will experience growth, the magnitude of which will be fairly large, especially in small towns such as Hayden. The impact from mining industry is already being felt. According to a Peabody coal representative, the Seneca II Mine, which will supply coal to the Colorado Ute Power Plant (which is not included in the population study), will employ 280 new mining employees and 150 construction workers. These would locate in the Hayden, Craig and Steamboat areas.

David Monarchi prepared population projections for 1980 for the Colorado Division of Planning for each county, which was



Charles Gathers and Associates, Denver, 1973

ROUTT COUNTY POPULATION PROJECTIONS

Predictions by Colorado Division of Planning

FIGURE E-3

published in 1973. The simulation models projected declines in Moffat and Rio Blanco County populations and an increased population by 61 percent for Routt County before 1982. However, Mr. Monarchi states his projections were, for the most part, based on data too old to be probable and that new projections need to be made based upon more recent trends.

In conclusion, the population growth of all three counties is destined to be upward and for the most part accelerated. Rio Blanco County may not expand as rapidly as the intensive oil shale profile predicts, or it may grow more rapidly from peripheral development or by the attraction of industry. Moffat County is experiencing a "boom" growth which is projected to be a continuing pattern. Routt County will be influenced by two distinct and not always compatible industries (mining and recreation), and the citizens will be making difficult decisions to bring a balance between the two for growth and for planning as well.

APPENDIX E-PART II

TABLE

E-3 Employment and Unemployment Characteristics for the Tri-County Region by Percent and Number of Persons; 1970

E-4 Agricultural Production Compared to Mining Production in Dollar Values

E-5 Agriculture Sales, Tri-County Region; 1969

E-6 Agricultural Statistics for the Tri-County Region, 1964 and 1969

E-7 Annual Per Capita Municipal Government Expenditures

E-9 Health Personnel, Moffat County; 1970

E-10 Health Personnel, Rio Blanco County; 1970

E-11 Selected Services, Tri-County Region, 1969

E-12 Selected Housing Characteristics, Year Moved Into Unit, Tri-County Area; 1970

E-13 Distribution of Owner Units by Price Range for the Tri-County Region and Colorado; 1970

TABLE E-3

EMPLOYMENT AND UNEMPLOYMENT CHARACTERISTICS FOR THE TRI-COUNTY REGION BY PERCENT AND NUMBER OF PERSONS 1970

	Moffat County				Routt County				Rio Blanco County				Region			
Occupation Group	**Employment**	**Percent**	**Unemployment**	**Percent**	**Employment**	**Percent**	**Unemployment**	**Percent**	**Employment**	**Percent**	**Unemployment**	**Percent**	**Employment**	**Percent**	**Unemployment**	**Percent**
Professional Technical & Kindred Workers	334	13.3	4	3.4	339	13.4	0	–	255	13.1	0	–	928	13.3	4	1.7
Farmers & Farm Workers	236	9.4	0	–	215	8.5	0	–	155	8.0	0	–	606	8.7	0	–
Managers & Administrators	354	14.1	0	–	215	8.5	0	–	204	10.5	0	–	773	11.1	0	–
Clerical & Kindred Workers	271	10.8	19	16.0	290	11.5	7	8.8	240	12.3	6	14.3	801	11.5	32	13.3
Sales Workers	163	6.5	18	15.1	104	4.1	4	5.0	52	2.7	0	–	319	4.6	22	9.1
Craftsmen, Foremen & Kindred Workers	339	13.6	6	5.0	341	13.5	0	–	286	14.7	7	16.7	965	13.8	13	5.4
Operatives, Transport	299	12.0	40	33.6	367	14.5	17	21.2	251	12.9	10	23.8	917	13.1	67	27.8
Private Household Workers	7	.3	0	–	31	1.2	0	–	31	1.6	0	–	69	1.0	0	–
Service Workers Excl. Household	290	11.6	18	15.1	390	15.5	39	48.7	269	13.8	14	33.3	949	13.6	71	29.5
Farm Laborers & Foremen	93	3.7	0	–	106	4.2	5	6.3	134	6.9	5	11.9	333	4.8	10	4.1
Laborers Excl. Farmers	117	4.7	14	11.8	129	5.1	8	10.0	69	3.5	0	–	315	4.5	22	9.1
Total	**2,503**	**100.0**	**119**	**100.0**	**2,527**	**100.0**	**80**	**100.0**	**1,946**	**100.0**	**42**	**100.0**	**6,976**	**100.0**	**241**	**100.0**

Source: U.S. Department of Commerce, Bureau of Census.

TABLE E-4

AGRICULTURAL PRODUCTION COMPARED TO MINING PRODUCTION IN DOLLAR VALUES ($1,000)

1969	Value all Agricultural Products Sold	Value All Crops Sold	Cattle	Hogs and Sheep
Moffat	7,718	1,237	3,029	3,293
Rio Blanco	5,600	545	3,497	1,457
Routt	9,921	1,344	7,230	1,134
Tri-County Region	23,239	3,126	13,756	5,884
Total Value	46,478 (including all other animals)			

Value of all Minerals

1970	All Minerals	Sand/ Gravel	Petroleum	Gas	Coal
Moffat	10,075	408	3,232	3,422	2,670
Rio Blanco	*43,365	3	39,099	4,140	11,346
Routt	11,627	106	241	430	19
Tri-County Region	65,066	517	42,913	7,564	34,320

*This figure jumped to $60,370,833 in 1972.
See Table

Sources: Chamber of Commerce, Bureau of Census, State of Colorado, the U.S. Department of Commerce and the Bureau of Land Management.

TABLE E-5

AGRICULTURE SALES
TRI-COUNTY REGION
1969

County	Value All Agricultural Products Sold ($1,000)	Value All Crops Sold		Beef Cattle		Hogs & Sheep		Other Animals	
		($1,000)	Percent All Products	($1,000)	Percent All Products	($1,000)	Percent All Products	($1,000)	Percent All Products
Moffat	7,718	1,237	16.0	3,029	39.2	3,293	42.7	159	2.1
Routt	9,921	1,344	13.5	7,230	72.9	1,134	11.4	213	2.2
Rio Blanco	5,600	545	9.8	3,497	62.4	1,457	26.0	101	1.8
Region	23,239	3,126	13.5	13,756	59.2	5,884	25.3	473	2.0
State	1,100,728	222,482	20.2	742,477	67.5	62,254	5.7	73,515	6.6

Source: Department of Agriculture

TABLE E-6

AGRICULTURAL STATISTICS FOR THE TRI-COUNTY REGION 1964 and 1969

	Moffat		Routt		Rio Blanco		Region	
	1964	1969	1964	1969	1964	1969	1964	1969
No. of Farms	275	303	359	353	191	170	825	826
Land in Farms (Acres)	1,118,628	1,255,393	678,014	587,835	630,595	556,564	2,427,237	2,399,792
Average Size of Farms	4,322	4,143	1,920	1,637	3,301	3,273	3,181	3,018
Value of Land & Buildings	NA	$49,510,653	NA	$85,261,953	NA	$35,620,393	NA	$170,392,999
Average Value Per Farm	$122,021	$163,401	$94,965	$241,535	$122,725	$209,531	$113,237	$204,822
Total Cropland (Acres)	105,130	124,279	124,916	133,250	59,056	54,319	289,102	311,848
Irrigated Cropland (Acres)	23,169	25,642	48,902	57,061	30,147	29,553	102,218	112,256
Operated By:								
Full Owners								
Farms	100	119	164	177	110	105	374	401
Acres	151,518	194,827	111,145	163,578	167,655	147,159	430,318	505,564
Part Owners								
Farms	147	142	151	148	60	56	358	346
Acres	971,932	921,244	373,025	492,736	411,685	389,235	1,756,642	1,803,215
Tenants								
Farms	24	42	28	38	15	9	67	89
Acres	28,734	139,322	46,034	21,700	24,697	20,170	99,465	181,192
Market Value of All Products Produced	$5,117,907	$7,718,259	$4,989,450	$9,920,560	$3,755,350	$5,600,100	$13,862,707	$23,238,919
Production Expansion	NA	$6,730,190	NA	$8,629,203	NA	$4,639,051	NA	$19,998,444
No. of Farms Hiring Laborers	156	163	201	178	135	100	492	441

TABLE E-6 (Continued)

	Moffat		Routt		Rio Blanco		Region	
	1964	1969	1964	1969	1964	1969	1964	1969
Wages Paid	$678,795	$726,418	$414,128	$624,271	$462,155	$500,340	$1,555,078	$1,851,029
No. of Workers By Days Worked:								
150 or more days:								
Farms	68	60	92	63	79	51	239	174
Workers	256	190	187	159	182	121	625	470
Less than 150 days								
Farms	NA	130	NA	158	NA	82	NA	370
Workers	NA	320	NA	453	NA	211	NA	984

Source: Census of Agriculture, 1964 & 1969, Statistics for the State and Counties.

TABLE E-7

ANNUAL PER CAPITA MUNICIPAL GOVERNMENT EXPENDITURES*

	Average of all Colorado Municipalities from 5,000-9,999 Population	Average of all Colorado Municipalities w/from 10,000-24,999 Population
General expenditures, all functions	98.69	90.67
Capital outlay	22.23	32.65
Other	52.44	58.02
Highways	25.63	22.04
Public welfare	.55	–
Health and Hospitals	1.23	12.47
Police protection	13.75	6.68
Fire protection	4.48	10.45
Sewerage	7.01	4.90
Sanitation other than sewerage	3.53	4.00
Parks and Recreation	7.48	5.65
Libraries	2.35	4.00
Financial Administration	3.01	3.52
General control	4.83	5.59
General public buildings	4.75	1.64
Interest on general debt	–	1.62
All other	2.33	13.03
Utility Expenditures	17.76	78.89

Source: THK and Associates

TABLE E-8

ANNUAL PER CAPITA LOCAL GOVERNMENT EXPENDITURES*

	Average of all Colorado Counties Less than 10,000 Population
Direct General Expenditures	$608.92
Capital Outlay	105.10
Other than capital outlay	503.82
Education	286.66
Other than capital outlay	228.14
Highways	96.06
Other than capital outlay	72.83
Public Welfare	85.37
Hospitals	23.70
Other than capital outlay	18.86
Health	2.16
Police protection	11.17
Fire protection	2.54
Sewerage	7.23
Other than capital outlay	3.52
Sanitation other than sewerage	1.71
Parks and Recreation	3.77
Natural resources	9.55
Housing and Urban Renewal	2.32
Correction	1.02
Libraries	1.83
Financial administration	10.70
General control	20.74
General public buildings	6.17
Interest on general debt	11.60
Other and unallocable	9.63
Water supply expenditure	$ 26.09
Total Per Capita Local Government Expenditures**	**$635.01**

*1967 Data expressed 1973 dollars
**Does not include general debt outstanding

Source: THK and Associates

TABLE E-9

HEALTH PERSONNEL, MOFFAT COUNTY, 1970

County Population	6,380
Dental	
Number of Dentists	2
Persons/Dentists	3,150
Medical	
Number of Doctors	5
Persons/Doctors	1,276
Active Registered Nurses	22

TABLE 10

HEALTH PERSONNEL RIO BLANCO COUNTY, 1970

County Population	4,761
Dentists	2
Persons/Dentist	2,421
M.D.'s and D.O.'s	5
Persons/Doctor	968
Number of Active Registered Nurses	20
Number of Hospital Beds	44
Number of Extended Care and Nursing Home Beds	26

Source: Club 20 Colorado, Colorado West Statistical Reference *(Grant Junction, Colorado: January, 1971), p. 15.*

TABLE 11

SELECTED SERVICES
TRI-COUNTY REGION
1967

Establishments	Moffat County	Routt County	Rio Blanco County	Tri-County Region
Hotels, Motels and Tourist Courts	32	29	18	79
Personal Services	19	13	14	46
Misc. Business Services	4	2	4	10
Motion Pictures	I	I	I	3
Other Amusement, Recreation	5	4	6	15
Auto Repair, Auto Services, Garages	14	*	9	23
Misc. Repair Services	12	8	14	34
Total Establishments	87	57	66	210
Total Receipts ($1,000)	$1,905	$1,387	$1,583	$4,875
Total Payroll ($1,000)	$ 390	$ 347	$ 424	$1,161
No. Paid Employees	112	120	75	307

Source: U.S. Bureau of Census: 1967 Census of Business

TABLE E-12

SELECTED HOUSING CHARACTERISTCS
YEAR MOVED INTO UNIT
TRI-COUNTY AREA
1970

	Moffat County		Routt County		Rio Blanco County		Tri-County Region	
Owner Occupied	Number	Percent	Number	Percent	Number	Percent	Number	Percent
1969-1970	121	8.6	266	17.4	140	15.5	527	13.7
1968	54	3.9	90	5.9	33	3.7	177	4.6
1965-1967	260	18.0	239	15.6	172	19.0	671	17.5
1960-1964	346	24.7	251	16.4	168	18.6	765	19.9
1950-1959	313	22.3	334	21.7	170	18.8	817	21.3
1949 & earlier	307	21.9	353	23.0	221	24.4	881	23.0
Total	**1,401**	**100.0**	**1,533**	**100.0**	**904**	**100.0**	**3,838**	**100.0**
Renter Occupied								
1969-1970	315	46.5	347	55.4	258	45.3	920	49.1
1968	122	18.0	110	17.6	57	10.0	289	15.4
1965-1967	146	21.5	73	11.7	101	17.7	320	17.1
1960-1964	34	5.0	58	9.3	87	15.3	179	9.6
1950-1959	21	3.1	13	2.1	47	8.2	81	4.3
1949 & earlier	40	5.9	25	3.9	20	3.5	85	4.5
Total	**678**	**100.0**	**626**	**100.0**	**570**	**100.0**	**1,874**	**100.0**

Source: U.S. Bureau of Census, Census of Housing, 1970, Detailed Housing Characteristics HC(1)B-7.

TABLE E-13

DISTRIBUTION OF OWNER UNITS BY PRICE RANGE FOR TRI-COUNTY REGION AND COLORADO

1970

	Moffat County		Routt County		Rio Blanco County		Region		Colorado	
Price Range	**No. Units**	**Percent**	**No. Units**	**Percent**	**No. Units**	**Percent**	**No. Units**	**Percent**	**No. Units**	**Percent**
Less Than $5,000	76	8.1	143	14.4	58	10.9	277	11.3	11,997	3.3
$5,000-$9,999	166	17.7	241	24.2	129	24.2	536	21.8	42,962	11.9
$10,000-$14,999	266	28.4	246	24.7	158	29.6	670	27.1	79,654	22.2
$15,000-$19,999	260	27.8	118	11.9	96	18.0	474	19.2	93,857	26.0
$20,000-$24,999	80	8.5	115	11.6	35	6.5	230	9.3	58,794	16.3
$25,000-$34,999	71	7.6	76	7.6	48	9.0	195	7.9	47,618	13.3
$35,000 or More	18	1.9	56	5.6	10	1.8	84	3.4	25,260	7.0
Total	**937**	**100.0**	**995**	**100.0**	**534**	**100.0**	**2,466**	**100.0**	**360,142**	**100.0**
Median Price	**$14,100**		**$11,500**		**$12,500**				**$17,400**	

Source: U.S. Bureau of Census, Census of Housing; 1970, General Housing Characteristics, Hc(1)-A7

APPENDIX F.

Adopted: March , 1974
Effective: August 1, 1974

Repeal and Reenactment
of Section II.D
Regulation No. 1

Emission Control Regulations for Particulates, Smokes, and Sulfur Oxides for the State of Colorado

II. PARTICULATE EMISSION REGULATIONS -

D. Fugitive Dust:

1. Effective Date and Affected Areas.

   a. The existing Section II.D. of Regulation No. 1 controlling fugitive dust shall be repealed effective July 31, 1974 and the new Section II.D as follows shall become effective August 1, 1974. This delayed effective date for the new Section II.D allows time for voluntary compliance with the new provisions.

   b. Sections II.D.3, 4 and 5 shall apply only to Commission designated air pollution control areas as shown on page 1.13 of this Regulation No. 1.

   c. Sections II.D.2, 6, 7, and 8 shall apply statewide.

2. Opacity Regulations for Fugitive Dust Emissions Emanating from Unenclosed Operations.

   a. No person shall emit or cause to be emitted from any source of fugitive dust whatsoever, any particulate matter which,

      (i) at or from the source of said emission, is of such a shade or density on the property of emission origination so as to obscure an observer's vision to a degree in excess of 20% opacity, or

      (ii) is visibly transported off the property of emission origination and remains visible to an observer positioned off said property when sighting along a line which does not cross the property of emission origination.

b. Exceptions from Opacity Regulation Section II.D.2(a).

(i) All unpaved roads and unpaved parking lots (covered by Section II.D.3).

(ii) Earth and construction-material moving and excavating activities except for crushing, grinding, milling, conveying, and bagging processes. (covered by Section II.D.4).

(iii) Demolition, wrecking, and moving of structures and explosives detonation activities. (covered by Section II.D.5).

(iv) Open mining activities. (covered by Section II.D.6).

(v) Agricultural cultivation activities (regulated in part by Section II.D.7).

(vi) Sources of fugitive dust which exceed opacity regulations for a period or periods aggregating less than three (3) minutes in any sixty (60) consecutive minutes.

(vii) Sources of fugitive dust from which dust emissions exceed opacity regulations when wind velocities exceed 30 m.p.h. as determined by one or more of the following practices as approved by the Division: By a one-hour average at the nearest official station of the U.S. Weather Service; by interpretation of surface weather maps by a qualified meteorologist; or by use of one or more anemometers at the site.

(viii) any other sources as specified by the Commission.

3. Unpaved Roads and Unpaved Parking Areas.

a. All new unpaved roads and unpaved parking areas:

a-1 No person shall construct or operate a new unpaved road, or new unpaved parking area unless a permit therefore has been granted by the Division pursuant to Section II.D.8.

a-2 Exceptions:

(i) Any new road or parking area which, after demonstration to the Division, will not exceed an average daily traffic count of 165 vehicles averaged over any consecutive 3-day period.

(ii) Any new road or parking area associated solely with housing or apartment projects of seven family dwelling units or less.

(iii) Any new road or parking area to be hard surfaced (concrete or bituminous binder and rock) within six (6) months of start of construction, except that the person constructing or contracting to construct said road or parking area shall notify the Division in advance of commencing construction of the nature, size, and location of the hard surfacing project and the dates on which the road or parking area construction project is to start and is to be completed. The person shall use abatement and preventive measures as outlined in II.D.9 during construction.

a-3 The Division may require the person owning or maintaining any new or existing unpaved road to supply traffic count information on a regular basis to the Division as necessary to determine if additional abatement and preventive measures or changes in the implementation time schedule are required of the person by the Division.

b. Existing Privately Owned or Maintained Unpaved Roads and Unpaved Parking Areas.

b-1 Any person owning any unpaved road or unpaved parking area or having a right-of-way easement or possessory right to use the same, found by the Division to exceed a maximum allowable traffic count of 165 vehicles per day averaged over any consecutive 3-day period, shall discontinue and prevent use of that road or parking area, unless the Division has approved a fugitive dust control plan which includes preventive measures as outlined in II.D.9 and unless the conditions of the approved plan are met continually.

c. Existing Publicly Owned or Maintained Unpaved Roads and Unpaved Parking Areas.

c-1 By July 1 of each year the Division shall submit to the political subdivision owning or maintaining unpaved roads or unpaved parking areas and to the Commission, a report on the nature and degree of the air pollution problems as related to emissions from said political subdivisions, existing unpaved roads and unpaved parking areas which exceed 165 vehicles per day averaged over any 3-day period based upon traffic count information as collected by the Division or the political subdivision.

c-2 Said political subdivisions shall submit a plan and progress report to the Division by October 1 of each year which includes a specified time schedule for the control of fugitive dust emissions on unpaved roads and unpaved parking areas as reported by the Division pursuant to Section II.D. 3(c-1). Said plans shall be based upon:

(i) availability of existing and new funds for paving or fugitive dust suppression;

(ii) use of preventive measures applicable to unpaved roads and unpaved parking areas as outlined in Section II.D.9.

4. Earth and Construction-Material Moving and Excavating except for Crushing, Grinding, Milling, Conveying and Bagging Processes.

No land developer of a new, or owner of an existing construction or land development project shall throughout the duration of the project, disturb or contract to disturb by grading, excavating or depositing on more total surface area than five (5) acres of land (in the aggregate) unless abatement and preventive measures as outlined in Section II.D.9 are being met continually. New sources regulated in this paragraph 4 must be granted a permit from the Division pursuant to Section II.D.8 prior to breaking ground.

5. Demolition, Wrecking and Moving of Structures and Explosives Detonation Activities.

a. No person shall conduct demolition, wrecking, or moving of structures or explosives detonation activities unless a permit therefore has been granted by the Division pursuant to Section II.D.8 and unless the provisions of Section II.D.9 are being met continually.

6. Open Mining Activities:

No developer of a new or owner of an existing open mining activity shall throughout the duration of the operation, disturb or contract to disturb by grading, excavating, or depositing on more total surface area than one (1) acre of land (in the aggregate) unless the provisions of Section II.D.9 are being met continually. New open mining activities must be granted a permit from the Division pursuant to Section II.D.8 prior to operation. Open mining shall be as defined in the Colorado Open Mining Land Reclamation Act of 1973 meaning the mining of natural mineral deposits of limestone used for construction purposes, coal, sand, gravel, and quarry aggregate, by removing the overburden lying above such deposits and mining directly from the deposits thereby exposed. The term includes, but is not limited to, such practices as open cut mining, open pit mining, strip mining, quarrying, and dredging.

7. Complaint Section:

When a complaint of dust or fugitive dust is registered with the Division by a single complainant or multiple complainants who allege that any dust or fugitive dust obstructs or interferes with the reasonable and comfortable use of his or their property, the Division shall investigate and if the Division finds that such conditions exist, the Division shall issue a citation to the person or persons from whose land or activity the objectionable emission emanates and shall require a fugitive dust control plan containing reasonable control measures where appropriate according to the abatement and preventive measures as outlined in Section II.D.9.

8. New Source Permit Requirements:

a. No permit shall be granted to an applicant unless the Division determines to its satisfaction that a plan has been submitted on forms provided by the Division which includes the following information:

a-1 A description of the nature and scope of the activity and of the existing or new sources of fugitive dust including but not limited to the following:

excavating
land leveling
repair or alteration
sand blasting
vehicle movement
screening
drying
waste disposal
detonation of explosives
earth moving
construction
demolition
handling
transporting
mining activities
crushing
site preparation
feed lots
campgrounds
fairgrounds
processing of sand, gravel and rock
cleaning
mixing
miscellaneous uses of land
beet piling grounds
storage
quarrying
unpaved roads
unpaved parking areas

a-2 Fugitive dust abatement and preventive measures as outlined in Section II.D.9.

a-3 A time schedule for fugitive dust abatement and prevention.

a-4 A description of any monitoring or sampling methods used for recording and reporting data to the Division.

b. The permit may be granted and renewed for any period of time as deemed appropriate by the Division.

c. The permit may be granted to any single applicant for any single project or combination of projects as deemed appropriate by the Division.

d. In the granting of a permit, the Division may impose any permit condition it deems necessary to attain and maintain compliance with the provisions of this Section II.D.

e. The Division may suspend, revoke, modify, or refuse to renew or grant a permit under the following conditions:

(i) the requirements of this Section II.D. have not been met;

(ii) the approved compliance or prevention plan has not been followed as determined by the Division, or

(iii) the permit conditions are not met.

f. Any appeal by an applicant of a denial or revocation of a permit shall be conducted in accordance with the provisions of Sections 66-31-12(4)(f), (g), and (h) of the Act.

9. List of Abatement and Preventive Measures.

a. Unpaved Roads and Unpaved Parking Areas.

a-1 Abatement and preventive measures shall be approved by the Division and may include but shall not be limited to frequent watering, addition of dust palliatives, detouring, paving, closure, speed control, or other means such as surface treatment with penetration chemicals (ligninsulfonates, oil, water, cutbacks, etc.) or methods of equal or greater effectiveness in reducing the air contamination produced.

b. Demolition, Wrecking and Explosive Detonation Activities; Earth and Construction Material Moving, Mining and Excavation Activities.

b-1 Abatement and preventive fugitive dust control measures shall be approved by the Division and may include, but shall not be limited to:

- wetting down, including pre-watering;
- landscaping and replanting with native vegetation;
- covering, shielding or enclosing the area;
- paving, temporary or permanent;
- treating, the use of dust palliatives and chemical stabilization;
- detouring;
- restriction of the speed of vehicles on sites;
- prevention of the deposit of dirt and mud on improved streets and roads and other such effective means of dust control as the Division may deem necessary;
- disturbing less topsoil and reclaiming as soon as possible.

b-2 Sequential blasting shall be employed whenever or wherever feasible to reduce the amounts of unconfined particulate matter;

b-3 Such dust control strategies as re-vegetation, delay of surface opening until demanded, or surface compaction and sealing, shall be applied.

b-4 Haulage equipment shall be washed or wetted down, treated, or covered when necessary to minimize the amount of dust emitted in transit and in loading.

b-5 These measures shall also be enforced during periods when actual construction work is not being conducted, such as on weekends and holidays.

# # # # #

NOTE: THE FOLLOWING DEFINITIONS ARE TO BE ADDED TO THE COMMON PROVISIONS REGULATIONS, SECTION I, ENTITLED, "DEFINITIONS."

Adopted : March 1974
Effective Date: August 1, 1974

AMENDMENT
TO
COMMON PROVISIONS REGULATIONS

I. DEFINITIONS:

FUGITIVE DUST - Solid airborne particulate matter emitted from any source other than an opening which channels the flow or air contaminants and then exhausts the contaminants directly into the atmosphere. Fugitive dust also includes solid particles released into the atmosphere by natural forces or by mechanical processes such as crushing, grinding, milling, drilling, demolishing, shoveling, conveying, covering, bagging, sweeping, etc.

LAND DEVELOPER - Any person, firm, corporation or governmental entity who initiates any change in the state of existing land use. The person, firm, corporation or governmental entity who contracts with others for construction services for said change in land use will be deemed to be the land developer.

(DELETE FROM COMMON PROVISIONS REGULATION - DEFINITION OF DUST)

ADD TO PAGE 12 OF REGULATION NO. 1:

I.A. Stationary Air Contamination Sources

2. Exceptions:

(e) THE PROVISIONS OF I.A.I. SHALL NOT APPLY TO FUGITIVE DUST.

APPENDIX G.

Appendix "G"

AIR RESOURCES CALCULATIONS

° Mining Rates -

Strip dimensions 5000 foot long x 120 foot wide

Coal seam depth = 13 foot (average)

Coal density = 80 lb./ft.

Coal mined per strip;

$$= 5000 \text{ ft.} \times 120 \text{ ft.} \times 13 \text{ ft.} \times \frac{80\text{lb}}{\text{ft}^3} \times \frac{\text{ton}}{2000\text{lb}}$$

= 312,000 tons/strip

Mining rate for first three years (Phase 1) = 600,000 ton/yr.

Strips mined per year = 600,000/312,000 - 2 (approx.)

Mining rate for years four through sixteen (Phase 2) =

3,000,000 ton/yr.

Strips worked per year - $(3 \times 10^6)/312 \times 10^3 = 10$ (approx.)

Acres excavated during Phase 1; = $\frac{5000 \times 120 \times 2}{43,560}$ = 27/yr.(approx.)

Acres excavated during Phase 2; = 135/yr. (approx.)

° Overburden Removal -

Overburden ratio = 5.1 yd^3/ton coal

Overburden density = 130 lb./ft.^3

Phase 1 overburden removal rate

$$= 600,000 \frac{\text{ton}}{\text{yr.}} \text{ coal} \times \frac{5.1 \text{ yd.}^3}{\text{ton}} \times \frac{27 \text{ ft.}^3}{\text{yd.}^3} \times \frac{130 \text{ lb.}}{\text{ft.}^3} \times \frac{1 \text{ ton}}{2000 \text{ lb.}}$$

$= 5.4 \times 10^6$ ton/yr.

Phase 2 overburden removal rate = 27×10^6 ton/yr.

Overburden average depth -

$$= (6{,}000{,}000 \times 5.1)\ \text{yd.}^3 \times \frac{27\ \text{ft.}^3}{\text{yd.}^3} \times \frac{1}{2 \times 500\ \text{ft.} \times 120\ \text{ft.}}$$

$$= 70\ \text{ft. (approx.)}$$

° Topsoil Removal -

Phase 1 - Two strips with topsoil depth of 12 in. - density 110 lb./ft.^{3}

$$\text{Rate} = 2 \times 5000 \times 120 \times \frac{12}{12} \times 110 \times 1/2000$$

$$= 66{,}000\ \text{ton/yr.}$$

Phase 2 -

Rate = 330,000 ton/yr.

° Dust Emissions

Operation 1 - Phase 1

$$\text{Topsoil removal rate} = 66{,}000\ \frac{\text{ton}}{\text{yr.}}$$

Emissions factor 0.10 lb./ton

$$\text{Emissions} = 66{,}000 \times 0.10 \times \frac{1}{2000}$$

$$= 3.3\ \text{tons/yr.}$$

Operation 2 - Phase 1

$$\text{Overburden transfer rate} = 5.4 \times 10^6\ \frac{\text{ton}}{\text{yr.}}$$

Emissions factor = 0.07 lb./ton

$$\text{Emissions} = 5.4 \times 10^6 \times 0.07 \times \frac{1}{2000}$$

$$= 189\ \text{tons/yr.}$$

Operation 3 - Phase 1

Area reworked = 27.0 acres/yr.

Emissions factor = 40 lb./acre

$$\text{Emissions} = 27 \times 40 \times \frac{1}{2000} = 0.5 \text{ ton/yr.}$$

Operation 4 - Phase 1 -

Identical to Operation 1 -

° Process Emissions -

Reduction equipment - In Phase 1 operations there will be two 650 ton/hr crushers in series; one primary and one secondary.

At 6000,000 tons per 365 - 24 hr. days per year

$$\text{Process rate} = \frac{600{,}000}{365 \times 24} = 69 \text{ ton/hr.}$$

Crushers will be operated about 3 hr./day

For a hammermill crusher handling dry coal at a rate of 650 ton/hr., a ventilation rate of 4000 cfm and a loading of 10 grain/cf would be expected.

$$\text{Emissions} = 4000 \frac{\text{ft.}^3}{\text{min.}} \times 10 \frac{\text{grain}}{\text{ft.}^3} \times \frac{1 \text{ lb.}}{7000 \text{ grains}} \times \frac{1 \text{ ton}}{2000 \text{ lb.}}$$

$$\times \frac{60 \text{ min.}}{\text{hr.}} \times \frac{3 \text{ hr.}}{\text{day}}$$

$$= 0.50 \text{ tons/day/crusher}$$

$$= 370 \text{ tons/yr. from both crushers}$$

In Phase 2 operations four 650 tons/hr. crushers in parallel-series arrangement will be used.

$$\text{Process rate} = \frac{3{,}000{,}000}{365 \times 24} = 345 \text{ ton/hr.}$$

Crushers will be operated about 7.5 hrs./day

$$\text{Emission} = \frac{4000 \times 10 \times 60 \times 7.5}{7000 \times 2000} = 1.3 \text{ tons/day/crusher}$$

$$= 1900 \text{ tons/yr. from 4 crushers}$$

Conveyors -

Assuming four conveyors for Phase 1 and eight for Phase 2, operating on the same schedule as the crushing equipment. At a ventilation rate of 3000 cfm for each conveyor transfer point and a loading of 5 grain/ct, then -

Phase 1 emissions from 4 conveyors

$$= \frac{3000 \times 5 \times 60 \times 3}{7000 \times 2000} \times 4 = 0.8 \text{ ton/day}$$

Annual emissions = 290 tons/yr.

Phase 2 emissions from 8 conveyors

= 4.0 tons/day

Annual emissions = 1500 tons/yr.

Form 1279—3
(June 1984)

BORROWER'S CA

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Draft environmental
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